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ADVERTISEMENT.

The extension of the scope of the National Museum during the past few years, and the activity of the collectors employed in its interest, have caused a great increase in the amount of material in its possession. Many of the objects gathered are of a novel and important character, and serve to throw a new light upon the study of nature and of man.

The importance to science of prompt publication of descriptions of this material led to the establishment, in 1878, of the present series of publications, entitled "Proceedings of the United States National Museum," the distinguishing peculiarity of which is that the articles are published in pamphlet form as fast as completed and in advance of the bound volume. The present volume constitutes the fifteenth of the series.

The articles in this series consist: First, of papers prepared by the scientific corps of the National Museum; secondly, of papers by others, founded upon the collections in the National Museum; and, finally, of facts and memoranda from the correspondence of the Smithsonian Institution.

The Bulletin of the National Museum, the publication of which was commenced in 1875, consists of elaborate papers based upon the collections of the Museum, reports of expeditions, etc., while the Proceedings facilitate the prompt publication of freshly-acquired facts relating to biology, anthropology and geology, descriptions of restricted groups of animals and plants, the discussion of particular questions relative to the synonymy of species, and the diaries of minor expeditions.

Other papers, of more general popular interest, are printed in the Appendix to the Annual Report.

Papers intended for publication in the Proceedings and Bulletin of the National Museum are referred to the Advisory Committee on Publications, composed as follows: T. H. Bean (chairman), A. Howard Clark, R. E. Earll, Otis T. Mason, Leonhard Stejneger, Frederick W. True, and Lester F. Ward.

S. P. LANGLEY,
Secretary of the Smithsonian Institution.

TABLE OF CONTENTS.

Page.

Allen, Harrison, M. D. (1) On a new subfamily of Phyllostome bats. (2) Description of a new genus of Phyllostome bats. (3) On Temminck's bat, Scotophilus temminckii... 437–444
NEW SUBFAMILY: *Natalinæ.*
NEW GENUS: *Ectophylla.*
NEW SPECIES: *Ectophylla alba.*

Bean, Tarleton, H., M. D. Description of a new species of star-gazer (Cathetostoma albigutta) from the Gulf of Mexico..... 121–122

——Notes on fishes collected in Mexico by Professor Dugès, with descriptions of new species (with Plate XLIV)..... 283–287
NEW SPECIES: *Algansea dugèsi, Fundulus robustus, Acara bartoni.*

Benedict, James E. Preliminary descriptions of thirty-seven new species of hermit crabs of the genus Eupagurus in the U. S. National Museum..... 1–26
NEW SPECIES: *Eupagurus alaskensis, E. aleuticus, E. patagoniensis, E. smithi, E. impressus, E. floridanus, E. exilis, E. albus, E. gladius, E. defensus, E. capillatus, E. brandti, E. dalli, E. tanneri, E. confragosus, E. cornutus, E. townsendi, E. rathbuni, E. minutus, E. purpuratus, E. hemphilli, E. beringanus, E. newcombei, E. undosus, E. kennerlyi, E. setosus, E. munitus, E. gilli, E. curaçaœnsis, E. californiensis, E. mexicanus, E. roseus, E. corralinus, E. coronatus, E. varians, E. cervicornis.*

—— Corystoid crabs of the genera Telmessus and Erimacrus (with Plates XXV–XXVII)..... 223–230
NEW GENUS: *Erimacrus.*

Bolles, T. Dix, Lieut. U. S. Navy. Chinese relics in Alaska (with Plate XXIV)..... 221–222

Cherrie, Geo. K. Description of two apparently new flycatchers from Costa Rica..... 27–28
NEW SPECIES: *Mionectes semischistaceus.*
NEW SUBSPECIES: *Ornithion pusillum subflavum.*

Eigenmann, Carl H. The fishes of San Diego (with Plates X–XVIII)..... 123–178

—— On the occurrence of the spiny boxfish (genus Chilomycterus) on the coast of California (with Plate LXXXI)..... 485

Fontaine, William M. Description of some fossil plants from the Great Falls coal field of Montana (with Plates LXXXII–LXXXIV)..... 487–495
NEW SPECIES: *Aspidium montanense, A. monocarpum, Pecopteris montanensis, Cladophlebis heterophylla, Zamites montanensis.*
NEW VARIETY: *Aspidium angustipinnatum* var. *montanense.*

Hay, O. P. On the ejection of blood from the eyes of horned toads..... 375–378

—— Some observations on the turtles of the genus Malaclemys..... 379–384

—— On the breeding, habits, eggs, and young of certain snakes..... 385–397

Holm, Theo. Notes on the flowers of Anthoxanthum odoratum L. (with Plate XLVIII)... 399–403

Howard, L. O. Insects of the subfamily Encyrtinæ with branched antennæ (with Plates XLVI–XLVII)..... 361–369
NEW GENERA: *Pentacnemus, Tetracladia, Calocerinus.*
NEW SPECIES: *Pentacnemus bucculatricis, Tetracladia texana, T. gracilis.*

Jordan, David Starr. A description of the golden trout of Kern River, California, Salmo mykiss Agua-Bonita..... 481–483
NEW SUBSPECIES: *Salmo mykiss agua-bonita.*

Linton, Edwin, Ph. D. Notes on avian Entozoa (with Plates IV–VIII)..... 87–113
NEW GENUS: *Epision.*
NEW SPECIES: *Filaria serrata, Echinorhynchus rectus, Distomum (?) verrucosum, D. flexum, Dibothrium exile, Epision plicatus, Tænia macrocantha, T. compressa.*

Rathbun, Mary J. Catalogue of the crabs of the family Periceridæ in the U. S. National Museum (with Plates XXVIII–XL)..... 231–277
NEW SPECIES: *Libinia macdonaldi, L. spinimana, L. mexicana, Pericera triangulata, P. atlantica, P. contigua, Macrocœloma tenuirostra, Othonia carolinensis, O. nicholsi, O. rotunda, Mithrax pilosus, M. hemphilli, M. sinensis, M. bahamensis, M. braziliensis.*

Page.

Ridgway, Robert. Descriptions of two new forms of Basileuterus rufifrons, from Mexico 119

NEW SUBSPECIES: *Basileuterus rufifrons jouyi, B. rufifrons dugèsi.*

Shufeldt, R. W., M. D. A maid of Wolpai, (with Plate I) 29–31

—— The evolution of house building among the Navajo Indians (with Plates XLI–XLIII) 279–282

Simpson, Charles T. Notes on the Unionidæ of Florida and the Southeastern States (with Plates XLIX–LXXIV) 405–436

NEW SPECIES: *Unio subluridus.*

Smith, John B., Sc. D. Revision of the genus Cucullia; revision of the Dicopinæ; revision of Xylomiges and Morrisonia (with Plates II–III) 33–86

NEW SPECIES: *Cucullia similaris, C. obscurior, C. dorsalis, C. bistriga, C. cinderella, Eutolype bombyciformis, Copipanolis borealis, C. fasciata, Xylomiges peritalis, X. ochracea.*

Stejneger, Leonhard. Preliminary description of new genus and species of blind cave salamander from North America (with Plate IX) 115–117

NEW GENUS: *Typhlotriton.*

NEW SPECIES: *Typhlotriton spelæus.*

—— Notes on collection of birds made by Harry V. Henson in the Island of Yezo, Japan (with Plate XLV) 289–359

NEW SPECIES: *Parus hensoni.*

NEW SUBSPECIES: *Hypsipetes amaurotis hensoni.*

—— Two additions of the Japanese avifauna, including description of a new species 371–373

NEW SPECIES: *Acanthopneuste ijimæ.*

True, Frederick W. An annotated catalogue of the mammals collected by Dr. W. L. Abbott in the Kilima-Njaro region, East Africa (with Plates LXXV–LXXX) 445–480

NEW SPECIES: *Mus aquilus, Dendromys nigrifrons, Sciurus undulatus.*

Williamson, Mrs. Burton M. An annotated list of the shells of San Pedro Bay and vicinity (with Plates XIX–XXII) 179–219

NEW SPECIES: *Vitrinella williamsoni, Amphissa bicolor.*

LIST OF ILLUSTRATIONS.

TEXT FIGURES.

	Page.
Front view of an embryo of Natalus stramineus	438
Mus aquilus	461
Dendromys nigrifrons	463
Sciurus undulatus	465
Megaderma cor	468

PLATES.

I. A maid of Wolpai	32
II. Genitalia of Cucullia	52
III. Genitalia of Xylomiges and Morrisonia	86
IV–VIII. Avian Entozoa	114
IX. Typhlotriton spelæus	178
X. Stolephorus compressus	178
XI. Clupea mirabilis	178
XII. Stolephorus ringens and delicatissimus	178
XIII. Atherinopsis californiensis	178
XIV. Clevelandia and Gillichthys	178
XV. Typhlogobius and Gillichthys	178
XVI. Sebastodes and Fierasfer	178
XVII. Oligocottus analis and Isesthes gilberti	178
XVIII. Zyphlogobius	178
XIX–XXIII. Shells of San Pedro Bay	220
XXIV. Alaskan mask with Chinese medals	222
XXV. Telmessus cheiragonus	230
XXVI. Telmessus acutidens, T. cheiragonus, and Erimacrus isenbeckii	230
XXVII. Erimacrus isenbeckii	230
XXVIII. Libinia setosa	278
XXIX. Libinia macdonaldi	278
XXX. Libinia spinimana	278
XXXI. Libinia dubia, L. emarginata, L. mexicana	278
XXXII. Pericera triangulata, P. contigua	278
XXXIII. Macrocœloma tenuirostra, M. camptocera	278
XXXIV. Othonia aculeata, O. lherminieri	278
XXXV. Othonia carolinensis, O. nicholsi	278
XXXVI. Othonia rotunda, Mithrax braziliensis	278
XXXVII. Mithrax (Nemausa) acuticornis, M. hemphilli	278
XXXVIII. Mithrax bahamensis, M. sinensis	278
XXXIX. Mithrax pilosus	278
XL. Tiarinia depressa, T. spinigera	278
XLI–XLIII. Navajo Indian houses at Fort Wingate, N. Mex	282
XLIV. Algansea dugèsi, Fundulus robustus, Acara bartoni	288
XLV. Wing feathers of Motacilla lugens	360
XLVI, XLVII. Eucyrtinæ	370
XLVIII. Anthoxanthum odoratum	404
XLIX–LXXIV. Florida unios	436
LXXV. Tree Daman	480
LXXVI. Pencil-eared oryx	480
LXXVII. Thompson's gazelle	480
LXXVIII, LXXIX. Abbott's antelope	480
LXXX. Damara-land pygmy antelope	480
LXXXI. Spiny boxfish	486
LXXXII–LXXXIV. Fossil plants from Montana	496

DATES OF PUBLICATION OF ARTICLES.

No. 887, March 28, 1892; 888, March 25; 889, August 2; 890, 891, 892, 893, August 5; 894, August 2; 895, 896, July 18; 897, 898, 899, 900, 901, 902, 903, 904, August 2; 905, 906, 907, 908, 909, September 19; 910, October 5; 911, 912, 913, 914, 915, October 26; 916, 917, 918, July 24, 1893.

PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

FOR THE YEAR 1892.

VOLUME XV.

PRELIMINARY DESCRIPTIONS OF THIRTY-SEVEN NEW SPECIES OF HERMIT CRABS OF THE GENUS EUPAGURUS IN THE U. S. NATIONAL MUSEUM.

BY

JAMES E. BENEDICT,

Department of Marine Invertebrates.

1. Subgenus **EUPAGURUS**.

Typical species **Eupagurus bernhardus** (L.).

Eupagurus with the large surface of the left hand horizontal. Species not inclined to be hairy.

2. Subgenus **TRIGONOCHIRUS**.

Typical species **Eupagurus trigonocheirus** Stimpson.

Eupagurus with the outer face of the left hand oblique and more or less triangular. In some cases it is flattened, in others concave, or very much swollen, as in *hirsutiusculus*. The species are frequently very hairy.

3. Subgenus **ELASSOCHIRUS**.

Typical species **Eupagurus tenuimanus** (Dana).

Eupagurus with the left hand very small, in some cases almost rudimentary. The large hand is always wide or broadly ovate, excepting in *munitus* and *gilli*, where the carpus is exceedingly wide, and the hand moderately so. Eye scale semicylindrical, grading to triangular, sharp pointed. Species not hairy; many of them very smooth and glabrous.

Proceedings National Museum, Vol. XV—No. 887.

4. Subgenus **LABIDOCHIRUS**.

Typical species **Eupagurus splendescens** (Owen).

Eupagurus with the manus of the left cheliped cylindrical. Under this section I have included but three species, the type, *E. mertensi* Brandt, and *E. parvus* nov.

Subgenus **EUPAGURUS**.

Eupagurus alaskensis.

Anterior portion of carapace a little broader than long. Rostral tooth produced to the base of the eye scales; lateral projections much less produced. Eye-stalks short and stout, constricted in the middle. The eye scales taper from the base to a blunt apex; the subterminal spine is conspicuous from above. The acicles of the antennæ reach the proximal end of the flagella and are three-sided; sides flat, iridescent. The inner margin is armed with from 12 to 16 short conical teeth, and is set with bunches of hair.

The merus of the right cheliped is very stout and strong, and extends beyond the eye by about one-half its length. The carpus is armed on its inner margin with a line of stout spines; there are also two longitudinal rows of spines on its upper surface; elsewhere thickly set with spiny granules. The hand is set with spiny granules forming a border on the outer margin. On the fingers the surface is very coarsely granular.

The left cheliped is much smaller than the right; its carpus has a row of strong spines on the inner margin, and a parallel row further down on the outer surface; otherwise it is set with spiny granules as in the large hand. The dactyl does not show from above any flattened surface, but from the prehensile edge to the outer margin it is evenly rounded.

The ambulatory legs of the right side overreach the right cheliped but little; in very large specimens not at all. The upper surface of the merus joints are a little flattened. The upper margin of the carpus is armed with a single row of spines. Upper surface of propodal joints flattened, armed with a row of short spines on the summit and elsewhere with spiny granules. The dactyls are very wide, compressed, and twisted. The upper surface is convex, its summit and margins each set with a row of granules. Between these rows are long, smooth, surfaces. The inner surface of the dactyl is flat. The outer surface is very convex near the proximal end, but becomes much more flattened near the tip.

In alcoholic specimens the general color above is a light purple with iridescent reflections; below, light, tinged with reddish. A red streak runs around the prehensile edge of the thumbs and behind the dactyls to the inner margins of the hands. There is an oblong patch of red

on the outer distal margins and on the inner upper surface of the merus joints of the cheliped. The lower outer surface of the carpal joints of the ambulatory legs are pointed with red. The propodal joints and dactyls are longitudinally streaked with red.

This species is very close to *bernhardus*, but is easily distinguished by its broader and shorter left hand, by the wide dactyls of the ambulatory legs, by the acicula, and by its pearly iridescence.

Alaska.

Eupagurus aleuticus.

Front with three teeth sharper and a little more prominent than in *alaskensis*. The middle or rostral tooth is not quite so much produced. Eye-stalks much stouter and some longer than in *alaskensis*. The eye scales are larger and less acuminate. The subterminal spine does not show from above. The acicles are broader at the base than in *alaskensis*.

The chelipeds are stout. The carpal joints are armed with numerous sharp spines. That of the left cheliped is three-sided, and not four, as in *alaskensis*. The dactyls of both hands show from above a smooth oblique surface, either flat or a trifle concave. In the small hand this surface is free from hair and granules; in the large hand it is bordered with short spiny granules, and the granules inclosed are very small. The spines of both hands are bifurcate, except those of the margin, which are simple. The dactyls of the ambulatory legs are very wide and thin. The upper surfaces are entirely occupied by a sulcus, deep at the base of the article, becoming shallow at the end. This character of the dactyls is sufficient to distinguish this species from any other species of the *bernhardus* type. The color is dark in most specimens.

Aleutian Islands.

Eupagurus patagoniensis.

Anterior portion of carapace a little broader than long. Front with three rounded lobes equally produced. Lateral lobes armed with a single small sharp spine pointing directly forward. The eye-stalks are stout, smallest in the middle, dilated and flattened at the corneæ, and enlarged but cylindrical at the base. Eye scales much as in *alaskensis*. The subterminal spine is black-tipped and shows from above. The acicles reach the base of the flagella. In form they are very closely like that of *bernhardus*, and not so much flattened as in the related Alaskan species.

The chelipeds are a little shorter than the ambulatory legs of their respective sides. Carpus of large cheliped shaped like that of *bernhardus*, but it is evenly set with short sharp spines with black points. Spines of upper surface of hand black pointed and arranged in about seven more or less distinct longitudinal rows. The hand is more than twice as long as broad. The outer margin is arcuate; the inner margin

is nearly straight. The prehensile edges of the fingers are armed with large tubercles slightly horny near the tips. The merus joints of both chelipeds are very smooth on their large surfaces, but bordered with spines below.

The left cheliped reaches to the base of the dactyl of the large hand. It is similar in shape and armature, with the exception of the prehensile edges of the fingers, which are much more horny. The carpus has an evenly convex outer and upper surface armed with spines.

The dactyls of the ambulatory legs are curved, bent and twisted as in *bernhardus* and allied species, but are not compressed.

Although this species differs from the typical species of the genus, in the horny tips of the fingers of the large hand, yet in all other respects it so closely resembles the characteristic species that I cannot place it outside the limits of the genus under consideration.

East coast of Patagonia.

Eupagurus smithi.

The three projections of the front are about equally advanced; all are angular but not sharp; the lateral are each armed with a short spine. The eye-stalks are short, stout, and much dilated at the corneæ. The eye scales are short and round. The small subterminal spine shows from above. The second article of the antennal peduncle has its outer spine produced and spinulose on the inner edge. The terminal article extends beyond the eye one-half of its length. The terminal article of the antennular peduncle originates opposite the distal end of the eye-stalk.

The merus of the large cheliped is compressed. Its anterior upper margin and a flattened patch on the distal upper surface are spiny. The carpus is covered with small spines, and the inner margin is set with about eight large sharp spines curved slightly forward. The outer surface of the carpus is flattened, making a distinct surface, but there is no dividing line of spines or granules. The hand is broadest at the middle of the palm. The outer margin is fringed with short, sharp spines. The inner margin is unarmed except the distal half of the dactyl, which has a few short spines. The upper surface is paved with flattened plates or tubercles, each of which is surmounted by a small spine. The plates are raised above the true surface of the hand and, as in similar cases, there are many irregular-shaped fissures between them. The plates themselves are not all circular, but many of them have a small deep sinus on one side.

The left cheliped is strong and reaches the proximal end of the dactyl of the large cheliped. Its merus is much compressed, making its upper margin thin. The distal end of this margin is armed with two strong spines, which project directly forward over the carpus. The carpus is broad; its inner edge is crested with sharp spines. The upper surface is covered with small spines, as in the other cheliped. The hand is en-

tirely bordered with spines, and its surface is horizontal and covered with plates, as in the large hand.

The ambulatory legs are moderately stout, with slender, curved, and twisted dactyls. The carpal and propodal joints are crested with spines. The spines on the propodal joints of the second pair are very small. The dactyls are broadest two-thirds of their length from the propodal joints and are bordered with hair above and with spines and hair below.

The color in alcoholic specimens is pink.

Gulf of California.

Eupagurus impressus.

Anterior portion of carapace about as broad as long, flattened. Rostral projection on a line with lateral projections, much rounded. Lateral projections angular. Eye-stalks long, slender, dilated, and flattened at the corneæ. Scales semioval. Subterminal spine large. Aciculæ slender, very hairy, not extending beyond the eye-stalks.

The chelipeds are stout and strong. The large hand is much wider than the carpus. Its outer margin is arcuate, set with about twenty blunt teeth. The inner margin is without marginal spines or granules except at the distal end of the dactyl, where the margin beyond the angle is spiny. The upper surface is covered with granular plates, making a nearly even surface above the true surface. There is a depression near the outer margin opposite the base of the dactyl, and another running from the carpus nearly to the gape of the fingers in each hand.

The left hand is broader in proportion to its length than the right. Its surface is about the same in character. The arcuate outer margin is set with teeth, with small angular projections near the base of each. The inner margin is nearly straight, behind the dactyl having a row of five or six teeth. The margin of the dactyl is tuberculate.

The ambulatory legs extend but little beyond the cheliped. The dactyls are hairy and a little bent and twisted.

This species is allied to *pollicaris*.

Florida.

Eupagurus floridanus.

Anterior portion of carapace wider than long. Rostral projection rounded; lateral projections angular and a little in advance of the rostral. Eye-stalks slender, much flattened and dilated at the corneæ, and dilated at the base. Eye scales elongated, conical, with a large subterminal spine. The aciculæ of the antennæ do not extend beyond the the eye. The ultimate joint of the antennulæ is more than twice as long as the penultimate.

The chelipeds are very much as in *pollicaris*, but the hands are much narrower. The angle of the outer margin of the dactyl of the large hand is much nearer its base. The outer margin of the hand is not so much rounded and the bordering granules are not so prominent as

in *pollicaris*. The upper margin of the carpal and propodal joints of the ambulatory legs are spinulose. The dactyls are slender, curved and twisted.

Florida.

Eupagurus exilis.

Carapace flattened, depressed, wider than long. Front with a sharp triangular rostral tooth in line with the much rounder lateral lobes, which are armed with two short sharp spines directed forward and outward. The eye-stalks are short and stout, flattened at the corneæ. The scales are short, wide, and round at the end, the subterminal spine not showing ordinarily from above. Aciculæ of the antennæ not quite reaching the extremity of the eyes.

Chelipeds long and slender. The carpus is about as in *longicarpus*. The hand is much more than twice as long as broad, about equally arcuate on both margins. The fingers are slightly hooked at the tips. The left cheliped is as in *longicarpus* with the exception of a raised row of granules on the outer margin of the pollex.

The dactyls of the ambulatory legs are long, slender, curved, and twisted. The upper carpal margins are set with a row of small spines. These do not exist in *longicarpus*.

This species, while very closely related, is sufficiently distinct from *longicarpus*.

Off the Rio de la Plata.

Eupagurus albus.

Front with median projection angular, not produced much if at all beyond the lateral projections, which are also angular and are armed with a short spine which points outward. This spine or point does not arise below the margin, as is commonly the case with spines at this point, but is produced from the slightly raised margin. The eye-stalks are short, stout, and flattened; the corneæ are dilated. Eye scales short, triangular, wide at the base; the subterminal spine very small, sometimes seen from above, often not. The peduncles of the antennula and antenna extend beyond the eyes. The acicles are about as long as the eyes.

The right cheliped is long and slender. The upper anterior margin of the merus is armed with a few stout conical spines. The carpus is flattened on the inner surface and much rounded above and on the outer side. The upper surface is longitudinally divided into two parts by a median line of small spiny granules. The surface of the inner division is concave; the outer is convex. The hand is long, narrow, and is very slightly bent upward. The surface above and below is thickly set with rough, flattened granules. The inner border is conspicuously marked by a raised ridge. The fingers are slender and shorter than the palm.

The small cheliped barely reaches the large hand in large specimens.

The carpus is single crested; lower down is a parallel line of spiny granules which terminates with rather a large spine at the manus. The outline of the manus is slightly concave on its outer margin, while the inner outline is strongly convex. A sharp ridge runs along the outer margin of the hand and pollex. At the base of the pollex the depression is much deeper than farther along at either end of the ridge. The prehensile edge of the pollex is armed with small calcareous teeth, while the prehensile edge of the dactyl is armed with a comb of horny denticles.

The meral, carpal, and propodal joints of the ambulatory legs are stout, while the dactyls are very slender, much curved, and twisted. On each side of each dactyl a deep groove originates at the articulation with the propodus and disappears towards the end of the dactyl. There is a line of hairs on the upper margin.

This species is common in the Gulf of California.

Eupagurus gladius.

Anterior portion of carapace much broader than long. Rostral projection angular, pointed. Angles of the lateral projection more obtuse, pointed. Eye-stalks very stout, flattened. Scales short, wide. Subterminal spine small, often not showing from above. The acicles of the antennæ extend well beyond the eyes.

The right cheliped is very long. Merus rugose, its lower external distal angle produced and armed with several small spiny teeth. Carpus long, convex, its inner margin marked with a row of small spines of unequal length. Its upper surface is evenly set with spiny granules. The outer margin is marked by a dense row of these granules. The hand at its base is much narrower than the carpus. It attains its full width at the base of the dactyl, where it is not quite so wide as the carpus. The length of the hand in a typical specimen is 16 mm.; width 5 mm. The inner margin is marked by a line of granules. The granules of the upper surface are sharp and have a tendency to stand in more or less transverse rows. The outer margin is thin and is bordered by a row of very small blunt teeth. The fingers are thin and their prehensile edges are armed with calcareous tubercles.

The left cheliped scarcely reaches the base of the large hand. Its carpus has a double crest of spinules. The hand is bent outward. The fingers are thin and curved downward.

The ambulatory legs are slender. The outer spines of the crest on the carpus often have two or three points. The crest of the propodus is composed of much smaller spines than that of the carpus. The dactyls are thin, wide, curved, and twisted.

This species is closely allied to *longicarpus* and related species.

Gulf of California.

Eupagurus defensus.

Anterior portion of carapace broad and convex. Median process rounded, the margin of the front between the lateral processes being an

even curve. Lateral processes slender, pointed, and armed with a short spine. The eye-stalks are stout, much dilated, and flattened at the corneæ. The eye scales are broad, rounded, the anterior margin being a semicircle. The large, subterminal spine makes them appear at first sight very acute. The peduncle of the antenna extends beyond the eye by one-half the length of the terminal segment. The peduncle of the antennula extends beyond the eye by two-thirds the length of its terminal article. The acicle is a little longer than the eye.

The merus of the large cheliped is cylindrical at its base and swells out to the carpus. It has no angular surfaces. The carpus has three lines of sharp, slender spines, one on the inner margin composed of much larger spines, one on the outer margin, and one part way between the two. The hand is a little wider than the carpus at the base of the dactyl; its margin is set with a comb of long slender spines. A row of spines of about the same size and character runs from the gape of the finger to the wrist. Between the marginal and central rows are two diagonal rows of spines. On the outer surface of the hand, near the base of the pollex, is a patch of seven or eight spines. On the ridge of the pollex there are several rows of plates irregularly placed, and a small spine arises from the center of each. The fingers are hooked and gape widely.

The small cheliped reaches the base of the dactyl. Its merus is compressed. The carpus carries a double crest of spines; inner margin straight and flat; outer convex. The hand is armed with spines, as in the large cheliped, with the exception of the spine-bearing plates, which it lacks altogether. The fingers gape as in the large hand. In the small specimens the fingers do not gape in either hand.

The description is made from two specimens from the *Albatross* collection in the Gulf of Mexico.

Subgenus **TRIGONOCHIRUS**.

Eupagurus capillatus.

Anterior portion of carapace a little longer than broad. Lateral areas with numerous tufts of hair. Front with a broadly rounded, slightly produced, median projection. Lateral projections or lobes each armed below the margin with a strong spine. Eye-stalks long, slender, nearly straight. Scales semioval, with a strong subterminal spine. Acicle of the antenna not quite reaching the tip of the eye. Ultimate article of the antennula as long as the eye-stalk and extending nearly its full length beyond.

Right cheliped large. The merus is convex on the outer surface, nearly smooth; inner surface flattened and very hairy; spiny below. Carpus above convex, with small scattered spines; inner margin marked with a row of strong spines. Hand ordinarily twice as long as broad, rather sparsely set with stout spines.

Left cheliped with merus compressed. Carpus compressed, bicristate. Hand narrow and slender. Ambulatory legs stout. Dactyls curved and slightly twisted.

This species is much nearer its Atlantic representative *pubescens* than is any other North Pacific *Eupagurus* to its Atlantic analogue, and has long been confounded with it. The two are however distinct, and can be separated by careful comparison. *Capillatus* has the appearance of being much more hairy, the hairs often holding mud and dirt. Under the microscope, the main shaft of each hair is crowded with long fine hairs. In *pubescens*, the hairs show occasional spinules along the main shaft. The oblique face of the left hand in *capillatus* is more angular at its base and is not quite so long in proportion to its width as in *pubescens*. The large hand is more rounded. The spines are larger and not so numerous. The propodal joints are a little more flattened and a little shorter. The eyes are a trifle longer.

Alaska.

Eupagurus brandti.

Median projection of the front very little produced beyond the lateral. Lateral projections rounded and armed with a submarginal spine. Eyestalks rather stout, a little dilated at the corneæ. Scales triangular, bearing a bunch of coarse bristles. The acicle of the antenna extends a little beyond the eye.

The chelipeds are stout. Carpus armed above with small scattered spines. Hand very much swollen; outer margin arcuate; inner margin of palm and finger making nearly a straight line. Prehensile edges of fingers armed with three or four stout tubercles; tips horny.

Left cheliped small. Carpus compressed, bicristate. The oblique triangular face of the hand is markedly concave.

Ambulatory legs moderately slender, almost entirely unarmed. The dactyls are wide, curved, and slightly twisted.

The color of alcoholic specimens is reddish, the middle of the joints light. Spines everywhere red or red pointed.

This species is closely related to *kröyeri*, *trigonocheirus* and *dalli*. The small chelipeds of all have the triangular outer face, and in general the species resemble each other very much. With a large series of all I find substantial specific characters. *Brandti* and *dalli* are found together in a depth of from 15 to 85 fathoms in the Aleutian Island region. They grow to a length of three inches. They are separated at sight by a sharply defined band of white on the distal end of the merus joints of *dalli*, which is entirely wanting in *brandti*.

Eupagurus dalli.

Anterior portion of carapace very convex, about as broad as long. Median projection of the front triangular, produced beyond the lateral projections. Lateral projections rounded, each armed with a submar-

ginal spine. Eye-stalks smaller than in *brandti*. Eye scales triangular, with a large subterminal spine. The acicles reach but little beyond the eyes.

The width of the carpus of the large cheliped is less than two-thirds of its length, while the hand is more than twice as long as broad. The outline of the hand is nearly the same on both margins. The fingers are a little hooked, and the points cross when the fingers are closed, giving the pollex the appearance of being a little longer than the dactyl. The spines of the carpus and hand are small, slender, and sharp. The small cheliped has a triangular outer face.

The ambulatory legs are slender, the dactyls on the right side extending beyond the cheliped by about one-third their length. The dactyls are spinulose, a little curved, but not at all twisted. The chelipeds and ambulatory legs are hairy; the hair is very fine and not very conspicuous.

Alaska.

Eupagurus tanneri.

Front tridentate; teeth pointed, well defined. Rostriform tooth much larger and more produced than the lateral teeth. Ocular peduncles stout; corneæ dilated; scales ovate, with subterminal spine prominent, pointed. Second article of antenna short, stout; its outer angle produced to or beyond the middle of the penultimate article; inner angle armed with a slender spine. Acicle thin and flattened at its base, slender and subcylindrical for the greater part of its length. It reaches beyond the middle of the last article.

Right cheliped long, its merus extending beyond the eye for two-thirds of its length. Upper and outer side of merus cylindrical, its distal surface rendered uneven by tubercles and hairy rugæ, the rugæ becoming shorter at the proximal end. Carpus four-sided; upper side a little convex; much more so below; sides concave. Hand elongate, about as wide as the carpus; from about the middle of the palm it tapers gradually each way. Fingers thin and bent downward like curved scissors. A ridge beginning at the articulation of the carpus near the inner angle of the hand, runs diagonally across the hand and along the inner portion of the immovable finger. Another ridge beginning near the outer proximal angle of the hand runs across the hand and joins the first ridge a little behind the gape of the fingers. At this point the ridge is most elevated. The two ridges inclose a subtriangular area, in which there are five or six short spines. The ridges are spiny, the first one from its origin to the pollex, the second throughout its length. Both margins of the hand are spiny. On the outer margin the spines are regularly placed in a single row, extending to near the tip of the pollex. On the inner margin they form a double row, irregularly placed. There is a single row of spines on the margin of the dactyl. A row higher up unites with the first near the tip. Two marked depressions occupy the large part of the upper surface of

the hand. The one on the outer side begins on the pollex and runs backward, becoming deeper opposite the base of the dactyl and widest a little back of this. On the inner part of the hand the second depression begins along the articulation of the dactyl and runs back to the proximal margin. There are no granules or spines in this depression, and but few scattered spiny granules in the other. The surface of the hand is glabrous.

The left cheliped is small, reaching to the middle of the large hand. Merus compressed above, thickened below, and armed with sharp spines. Carpus compressed; upper surface flattened, each margin armed with a row of prominent sharp spines; lower surface convex, set with small tubercles. Outer face of the hand subtriangular, deeply concave. Upper margin of this face armed with a single row of spines, and the lower margin with a double row irregularly placed and much smaller. A short row of spines from the carpal margin unites with the upper marginal row, making this row appear double for a part of its length in small specimens. Fingers slender, bent downward; prehensile edges thin, even, and horny.

Ambulatory legs slender, in large specimens reaching but little beyond the cheliped on the right side, in small specimens extending beyond by one-half the length of the dactyl. Merus joints much compressed; upper surface flattened, rugose; rugæ hairy. Carpal joints armed on the upper margin with a single row of sharp spines. Propodal joints compressed above, irregularly set with short spines. Dactyls long, slender, twisted. Two lines of hair near the margins of the inner surface are very conspicuous. Outer surface convex, glabrous.

Alaska.

Eupagurus confragosus.

Front tridentate; teeth pointed; median tooth but little produced beyond the lateral. Eye stalks stout, tapering gradually to the dilated corneæ. Scales acuminate; subterminal spine long, stout. Second article of antenna stout, its outer angle produced to about the middle of the penultimate article. Acicles reaching but little beyond the eyes. Penultimate article subconical.

The right cheliped is stout, falling short of the tips of the ambulatory legs. Merus and carpus very much as in *tanneri*, but the merus is more spiny below and the spines of the inner upper margin of the carpus are larger in comparison with those of the outer margin than in that species. The hand is wider and stouter than in *tanneri*, but made up in much the same way. The outer margin is spiny while the inner margin is set with spiny granules. The raised triangle with its base on the articulation with the carpus is much broader. The ridge which runs from the inner angle to the immovable finger is granulate rather than spiny. The ridge on the inner side of the triangle is broken by a V-shaped notch, the broken parts changing direction at this point. The outer ridge of the triangle, a short line inside, and the apex are sparsely

set with spines. Depressions occur on both sides of the hand, as in the last species, but do not reach the carpal margin, the inner depression being entirely cut off by the ridge. The whole upper surface of the hand is set with spiny granules, between which the surface is glabrous. The fingers are thin, but do not curve downward.

The left cheliped is shorter and more slender than the right. Carpus compressed; upper surface flat; both margins armed with spines, those of the outer margin much the longer and a little hooked forward. The outer face of the hand is deeply concave; the surface is granulated; both margins are spinous, the spines evenly placed. The fingers are slender, with even, thin, prehensile edges.

The ambulatory legs on the right side reach but little beyond the large hand. Merus joints much compressed; those of the anterior pair armed with spines below. Upper margin of carpal and propodal joints armed with spines. Smaller spines exist on the carpal joints of the second pair, but not upon the propodal. The dactyls are curved and a little twisted, fringed with hair as in *tanneri*.

The two species are readily separated by the inner side of the raised triangle of the large hand. In this species it cuts off the inner depression of the upper surface from the proximal margin of the palm, while in *tanneri* this depression is allowed to reach the margin by a curvature of the ridge.

Alaska.

Eupagurus cornutus.

Anterior portion of carapace a little wider than long. Front tridentate; median tooth larger and a little more produced than the lateral. The eyes are stout and in length equal about one-half the width of the anterior portion of the carapace. Acicles slender, subcylindrical, extending one-half their length beyond the eyes; external spine produced; its apex slender; the inner margin armed with three or four slender teeth.

The right cheliped is long and stout. The distal end of the merus is armed with short spines above and below; its upper surface is sparsely granulated posteriorly; anteriorly it is set with short transverse rugæ, from which lines of hair reach forward along the surface. The upper surface of the carpus is subrectangular; its linear margins sharply defined by rows of conical spines, those of the inner margin being much the larger; a third row of irregularly placed spines runs parallel to the inner margin. The hand swells out at its articulation until it is a little wider than the carpus, when the margins of the hand are nearly parallel to a point a little beyond the gape of the fingers. From this point to the tip of the immovable finger the outer margin is nearly straight, the dactyl gently curving to the tip. The outer margin is armed with a single row of spines and is fringed with fine hair. The margin of the dactyl is the same in character, but the spines are much smaller. A strong, rounded, granulated ridge begins near the wrist on the inner side

of the hand and runs diagonally to the end of the pollex; just behind the gape of the fingers it is elevated to a horn or tubercle. In all specimens the anterior outline of the horn is perpendicular to the hand. In small specimens the posterior outline is straight from the apex of the horn to the beginning of the ridge near the wrist. In large specimens the horn is much more elevated than the straight lines of the ridge. An auxiliary, spiny ridge, running from the outer middle of the wrist to the horn, cuts off an elevated subtriangular area on the posterior part of the hand. This area is somewhat spiny. The outer portion of the hand is deeply concave and its surface roughened by spiny granules. The inner side of the hand is deeply excavated, the cavity running in under the ridge and horn. The fingers are thin, granulate, the prehensile edges set with blunt teeth.

The left cheliped is much smaller than the right, reaching beyond the articulation of the dactyl of the large hand. The merus is compressed above, flattened beneath; margin spiny. Carpus compressed, flattened above, bicristate. The outer face of the hand is subtriangular, deeply concave or excavate; surface granulate; margins spiny.

The ambulatory legs of the right side reach but little beyond the cheliped. Merus joints of first pair much compressed, armed with small spines below; carpal joints armed with larger spines above. The second pair are without spines. Dactyls flattened, curved, twisted, channeled on each side near the articulation of the propodus; inner surface with a line of hair near each margin.

Alaska.

Eupagurus townsendi.

Rostriform tooth sharp, produced slightly beyond the base of the eye scales. Lateral projections of the front but little produced. Eye peduncle constricted at the base, dilated at the cornea. Scales small. Acicles of antennæ slender, extending beyond the eyes for nearly half their length.

The chelipeds are long, the merus joints extending beyond the eyes by about one-half their length; spiny below. The carpus of the right cheliped is five-eighths as wide as long, its inner margin with a row of spines about one-third larger than those scattered about the surface and about double the size of the spines of the outer margin. The upper and lower surfaces are convex; outer and inner surfaces flat or slightly concave. The hand is more than twice as long as wide, thinly spinous. The spines of the outer margin are about the same size as those of the surface, and very much larger than those of the inner margin. There are two rows of spiny granules on the dactyl, with a flat surface between. The hand is evenly convex above and below. The fingers are slightly bent downward.

The left cheliped reaches the base of the dactyl of the large hand; it is compressed. The carpus has a flat upper surface, with a row of small spines on each margin. The hand has a subtriangular and slightly

concave outer face. The upper margin is armed with a row of slender spines.

Ambulatory legs slender; dactyls long, slender, much bent, twisted. Those of the right side reach beyond the cheliped by about one-fourth their length. Merus joints of first pair with six or seven spines below; carpal joints spiny above. Carpal joints of the second pair spiny above, but the spines are very small.

Chelipeds and ambulatory legs sparsely hairy; hairs fine and short, not conspicuous. On the hand the hair arises in little bunches scattered among the spines.

Color in alcohol, orange-buff.

Alaska.

Eupagurus rathbuni.

Median projection of the front acute, produced much beyond the lateral projections. Eye peduncles stout, very little constricted, dilated at the corneæ. Scales rather broad, rounded. The acicles reach to the end of the eyes.

Chelipeds long. The merus joints overreach the eyes by about one-half their length. The carpus of the large cheliped is seven-tenths as wide as long, convex on three sides, concave on the inner side, spinose; the spines small. Spines of the inner margin but little if any larger than elsewhere. The distal inner angle of the upper surface is occupied by a small circular patch of very fine hair. The hand is about three-sevenths as wide as long, evenly rounding at the palm, spiny above, with a scarcely distinguishable marginal row of spines. The merus and carpus have a few short spines below. The upper part of the carpus of the left cheliped is flat, with marginal row of very small spines. The hand is small; fingers slender and strongly bent downward.

The ambulatory legs of the right side overreach the cheliped but little; those of the left side, by about one-half the length of the dactyl. The anterior pair have the lower edges of the merus joints set with spiny granules. The carpal joints have a row of very small spines on the upper margin. The dactyls are wide, bent, and twisted. The margins of the inner surface are hairy.

The distal upper margin of the meral and carpal joints is a light red. There is also a streak of red on the large hand at the base of the dactyl. The ambulatory legs are tinged with the same color near the joints and on the upper distal third of the meral joints. The general color is pale.

This species is readily distinguished from any other north Pacific form by the patch of hair on the carpus of the large cheliped.

Alaska.

Eupagurus minutus.

Anterior portion of carapace broadly rounded at the sides, much constricted behind. Front nearly straight, faintly three-lobed. Eye-stalks

long, stout. Scales short, rounded, with a slender subterminal spine. Acicle of antenna shorter than the eye. Peduncle scarcely if any longer than the eye.

Merus of right cheliped short, compressed. Upper surface of carpus triangular; inner margin armed with slender spines; a few scattered spines on the surface. The hand is much longer than wide. The inner margin of the manus is set with long slender spines, as also the outer edge of the dactyl. Spines of the outer margin much smaller. Two rows of slender spines beginning at the carpus run together at the base of the pollex.

Carpus of left cheliped single-crested with slender spines. The oblique subtriangular face of the hand is bordered by very sharp spines. The upper surface is about equal to the oblique surface in extent.

The specimen is hairy.

Gulf of California.

Eupagurus purpuratus.

The median projection of the front is rendered sharp by a rostral point which originates on the upper surface and extends beyond the margin. The triangular lateral projections are not armed with a spine. The eye stalks are stout and long. The eye scales are acute, concave, and have a prominent, slender, subterminal spine. The lateral projection of the second article of the antennal peduncle is long and is conspicuously armed with spines on its inner margin. The peduncle is but little if any longer than the eye. The acicle is setose and much shorter than the eye. The peduncle of the antennula is much longer than the eye.

The carpus of the large hand widens out evenly from the merus, making the outline straight; outer margin unmarked by special line of granules or spines; inner margin defined by a row of five or six spines which are very sharp and point forward; upper surface coarsely granulated. The hand has a symmetrical outline and is fringed from the tips of the fingers to the wrist with blunt spines. Those on the outer margin originate on the lower surface and project above the upper surface. A strong ridge beginning at the tip of the dactyl runs backward and is continued on the manus and ends at the wrist. The whole upper surface of the hand is paved with large flattened compound granules. These granules seem to be hemispherical and a little elevated above the true surface, often showing irregular shaped fissures between them. The tubercles or spines on the inner margin of the hand are not so thickly set as on the outer.

The carpus of the small cheliped has a single crest armed with three or four strong spines. The hand has a curved oblique face and also a horizontal face equally prominent. This hand is also paved with compound granules. The lower margin of the oblique face is sparsely set with tubercles.

The ambulatory legs are slender. The dactyls are curved and spinose. The propodus and dactyl of the second pair on the left side are very thickly fringed with hair above and below. These articles are also seen to be wider and much more prominently grooved than the similar members of the other legs. As I have never seen this character before, I conclude that it may be accidental.

Color in alcohol, dark purple.

Described from a single specimen from the Galapagos islands.

Eupagurus hemphilli.

Anterior portion of carapace very much longer than broad. Median projection of front sharp. From the projection the margin curves back, making a lobe between the eye and antenna, but no sharp angle. A sharp spine arms the lower margin at this point, making the front sharply tridentate in appearance. Between the spine and the outer angle is another concave space behind the antenna. The eye stalks are long and slender, a little constricted in the middle. The eye scales are small and sharp, with well developed subterminal spines. The peduncle of the antenna overreaches the eye a little. The acicle is much shorter than the eye-stalk. The antennula extends but little beyond the eye.

The right cheliped is long. The merus is much compressed, twice as long as broad. Its outer surface is quadrilateral, smooth, almost glabrous, with a few fine hairs in very small bunches. There is a very small tubercle at its lower posterior angle. The carpus is more than twice as long as broad; deep; upper surface convex; inner and outer surfaces flattened. The hand is fully twice as long as its greatest breadth. It is not so wide as the carpus at its articulation, but widens out uniformly and is widest at the base of the dactyl. Both fingers are much shorter than the palm. The carpus and hand are densely and evenly granulate. The granules are white.

The small cheliped is much compressed and reaches but little beyond the carpus of the large cheliped. The carpus has a crest of about nine sharp spines and no trace of a rudimentary and second line. The hand is very much compressed, being no wider than the carpus. Its broad outer face is parallel with its inner. On the upper margin behind the gape is a deep suture extending from the carpus nearly to the base of the finger. The sides of this groove are armed with spiny granules. Both carpus and manus are very granular.

The ambulatory legs are slender and much compressed. The carpus and propodus of the first one on the right side are armed on the upper border with small spines. The feet of the second pair are of almost even length and reach the middle of the large cheliped. The dactyls are short, curved, and spinulose.

The color in alchohol is a bright red. There is a well marked light spot on the sides of the dactyls near the end.

This species is in appearance much like *granosimanus*, but is altogether distinct. It is readily separated by the front, by the much greater proportionate length of the outer portion of the carapace and by the very different left hand, and numerous other points. The young can be distinguished best by the length of the carapace.

California.

Eupagurus beringanus.

Anterior portion of carapace longer than wide. Median projection of the front very obtuse; lateral projections merely indicated. Eye-stalks very slender. Eye scales small, triangular; subterminal spine slender. A line of hair runs along the eye-stalk from the scale to the cornea. The last article of the antennula overreaches the eye by about one-half its length. The acicle is small and much curved; hairy along the inner margin; reaching nearly to the base of the cornea.

The right cheliped is stout. The upper margin of the merus is angular, with a patch of small and very sharp spines near the anterior border, which is also spinose. There are two prominent tubercles underneath. The carpus is convex on the upper surface, and flattened and comparatively smooth on the sides. The granules of the upper surface are large and not at all crowded. There are two rows of tubercular granules, one on the inner margin and one nearly parallel with it higher up on the surface. The hand is the same width as the carpus. Its granules are of widely different sizes and are not crowded. A row of tubercular granules defines the outer margin. The outer margin of the dactyl has a similar border. Fingers with very slight horny tips.

The small cheliped reaches a little way beyond the carpus of the large one. Its carpus is compressed; upper margin short, armed with from ten to twelve slender sharp spines. The oblique triangular face of the hand is convex and granular; a deep notch or groove occupies the posterior portion of the upper margin.

The ambulatory legs extend but a trifle beyond the large cheliped. The upper margin of the carpal and propodal joints of the first pair and of the carpal joints of the second pair are armed with short sharp spines. The dactyls are flattened. The legs are hairy. The hair of the upper margin is long and arises in tufts or fascicles.

The distal ends of the joints of the legs are a bright red. Both proximal and distal ends of the dactyls are red. The light portions of the legs are spotted with red.

This and the following species from British Columbia are much alike in color. The young are difficult to separate. Our specimens come from Bristol Bay and north of the Aleutian Islands.

Eupagurus newcombei.

Anterior portion of carapace longer than wide. Median projection of front very short, obtuse. Lateral projections barely indicated. The

eye-stalks are comparatively shorter and stouter than in *beringanus*. The scales are triangular; subterminal spines very large. The acicles reach nearly to the tip of the eye.

The right cheliped is large, shaped as in the last species, but differently armed. On the lower anterior portion of the merus there are two prominent tubercles, one of which is spiny as in the large cheliped. The carpus is bordered on its inner margin by a prominent row of short spines; near this is a parallel row of spines; the remainder of the surface is sparsely covered with spiny granules. The hand is irregularly set with spines about the same size as those of the carpus. The fingers are horny tipped.

The carpus of the small cheliped has a single crest of spines. A few much smaller spines are scattered about the outer surface. The outer surface of the hand is convex and set with spines.

British Columbia.

Eupagurus undosus.

Front tridentate; middle tooth but little produced. All are small and are not widely separated. Eye-stalks slender, but little dilated at the cornea. Scales pointed, subtriangular. The acicles of the antennæ are as long or a little longer than the eyes.

The right cheliped is much larger than the left; in proportion to the body it is large and strong. Outer surface of the merus smooth and glabrous, sprinkled with minute granules; lower margin armed with short conical spines tipped with red. Carpus four-sided; upper surface subrectilinear, thickly set with short spines tipped with red; lateral surfaces slightly concave. The outer margin of the hand from its posterior third rounds forward to the end of the pollex. The upper surface is thickly set with spiny granules, those on the outer margin being a little larger. The triangular oblique surface of the small hand is covered with tubercles as in the large hand. Both hands are characterized by peculiar depressions. The one on the inner upper surface of the large hand has straight sides and runs back to the carpus. The depression on the outer upper surface is variable. In the small hand the depressions are irregular and extend along each margin, while the central portion is occupied by a raised ridge.

The ambulatory legs of the right side are of equal length and reach to the end of the cheliped. The legs of the left side overreach the small cheliped by about one-half the length of the dactyl. The carpal joints of the first pair are armed on the upper margin; those of the second pair are smooth. The dactyls of all are short, stout, and spinulose.

In the chelipeds the color is a reddish orange. The extremities of the joints of the ambulatory legs are red, and the intermedial parts very light. The specimens are all more or less hairy.

Bering Sea.

Eupagurus kennerlyi Stimpson.*

Anterior portion of carapace a little longer than broad. Median projection of the front short, triangular. The lateral projections are rounded, but have a sharp appearance from the submarginal spine. The eye-stalks are straight, slender. The scales are acute, with large subterminal spines. The acicle of the antenna is slender, hairy, and does not reach to the end of the eye-stalk.

The merus of the large cheliped is nearly trihedral; outer surface smooth, without ornamentation of any kind; lower margin spiny. The carpus is set on the inner margin with seven or eight slender curved spines. The hand is a little wider than the carpus, and is traversed by seven rows, including the marginal rows, of slender light-colored spines. The prehensile edges of the fingers are armed with stout tubercles; tips horny.

Merus of left cheliped compressed; lower margins spiny. The carpus is a little compressed, bicristate. The hand reaches a little beyond the base of the dactyl of the large hand; it has an outer trigonal surface well set with large spines. Fingers horny-tipped. Ambulatory legs stout. Color in alcohol reddish.

Alaska.

Eupagurus setosus.

The carapace is very convex, little longer than broad. Median projection of front rounded, a little in advance of the lateral projections. The eye-stalks are much stouter and shorter than in *kennerlyi*. The scales are very small and acute, with large subterminal spines. The acicles of the antennæ reach beyond the eye one-fourth of their length.

The chelipeds have very much the same form as in *kennerlyi*, but the spines throughout are much shorter. The fingers are armed on the prehensile edges with large tubercles; points horny. The merus of the small cheliped is compressed. The carpus is thick, bicristate; sides compressed. The hands of both chelipeds are thickly set with stiff bristles, which character will separate the species at sight from *kennerlyi*. Color in alcohol light yellow.

Alaska.

Subgenus **ELASSOCHIRUS.**

Eupagurus munitus.

Anterior portion of carapace very smooth, with an occasional tuft of hair and a few pits or small, shallow depressions on the lateral regions. Front tridentate; teeth of nearly equal prominence. Eye scales long, sides subparallel, edges upturned, making the surface deeply concave; the ends round; subterminal spine not showing from above. The first article of the antenna is armed with a very small spine which points forward and outward. The inner angle of the second article is armed

* This description is inserted to mark the relationship of *setosus*.

with a sharp, conical spine; the outer angle is produced to the proximal end of the last article; the apex is ordinarily double pointed. Acicle rounded, hairy on the inner margin, reaching to the tip of the eye.

Chelipeds very unequal. In medium and small specimens the merus of the right cheliped does not reach beyond the eye, while in large ones it reaches beyond by one-half its length. It is three-sided; upper side convex; lower side flat; outer distal angle, with one or two short spines; upper ridge armed with a few spiny tubercles. The length of the carpus is only four-fifths of its width. Both sides are thinned out in wing-like expansions which turn down in such a way as to make the under side deeply concave. The distal angles of the expansion extend forward beyond the articulation of the manus, the anterior and lateral margins forming rectangles. The outer margin is smooth, regularly curved; the inner margin is serrate; the margin at the articulation of the manus is spiny, the spines short, sharp, and conical. The middle portion of the carpus is elevated, rather more angular than rounded. The proximal two-thirds of the ridge is set with spiny tubercles. In small specimens these tubercles are perceptible near the articulation of the merus; in large specimens they are larger and much more extended. The hand is much narrower than the carpus, being more than twice as long as its greatest width. It is comparatively thin; its outer margin concave; inner margin arcuate; upper surface rendered uneven by reticulate lines of small granules. Both fingers are concave above and convex below; prehensile edges armed with large white tubercles; tips not horny.

The carpus of the left cheliped is flattened, inner edge spiny. The hand is very much flattened; viewed from above it is boat-shaped. The edges are upturned, making it evenly concave. The proximal margin overlaps the distal margin of the carpus, the reverse being the case in most species of the genus. The fingers are slightly bent downward.

The ambulatory legs are slender, shorter than the cheliped, equal in length on both sides. The carpal joints are spiny above, and the propodal joints nearly smooth. The dactyls are short, flat, not twisted, spinulose on the margins of the inner surface. Hair almost entirely wanting.

Color in alcohol: The meral and carpal joints of the chelipeds are a light purple. Hands yellow. Ambulatory legs dark reddish orange, with small circular light spots.

Alaska.

Eupagurus gilli.

This species is very closely related to the preceding. The eye-stalk is much more slender. The acicle is shorter and does not reach the extremity of the eye. The chelipeds have about the same proportion. While in the last species the carpus of the large cheliped is somewhat angular and tubercular, in this it is rounding and smooth. The inner margin is slightly roughened; the outer margin is smooth; the anterior

margin is set with small tubercles. The outline of the large hand and the prehensile edges of the fingers are as in the preceding species. The ambulatory legs are relatively stouter. The dactyls are very much wider, and the inner surfaces are concave and spinulose.

Color of alcoholic specimens light ochre.

Alaska.

Eupagurus curaçaoensis.

Anterior portion of carapace a little longer than wide. Median projection produced, sharp; lateral projections rounded. Eye-stalks stout, flattened, dilated at the corneæ. Acicles much longer than the eyes. External spine of antennæ reaching the base of the cornea. Flagella very slender, reaching the end of the large cheliped.

Merus of large cheliped trigonal, very convex; upper and outer face squamose; lower external angle spinulose. Upper surface of carpus subtriangular, granular; inner portion with a few scattered minute spines; middle and outer portions with scattered tubercles in bunches of two or three arranged transversely; the outer margin is slightly raised and inconspicuously tuberculose; the inner margin is thin and serrate. The hand is thin and wide, evenly and minutely granulate; the edges are thin and slightly upturned and crenulate. The upper surface of the dactyl is divided by a ridge running from the tip to the articulating condyle.

Left cheliped much smaller than the right. Carpus flattened on top; margins spiny. Hand with a thin elevated ridge running from the end of the pollex to the wrist, making a deeply concave subtriangular outer face.

Ambulatory legs compressed. Upper margins of carpal and propodal joints sharp and spiny. Dactyls very thin, wide, bent and twisted.

Color of ambulatory legs in alcohol. Meral, carpal and propodal joints light red with wide band of light in the center of each. Distal half of the dactyl reddish; proximal half, light.

This species is closely related to *E. carneus* Pocock (Ann. and Mag. of Nat. Hist., vol. IV, No. 24, 1889).

Eupagurus californiensis.

Anterior portion of carapace about as broad as long. Median projection of the front sharp, in advance of the short angular lateral projections. Eye-stalks moderately long and slender. Scales long, pointed, concave. The acicles of the antennæ reach the ends of the eye-stalks.

Merus of large cheliped trihedral, smooth. Surface of the carpus subtriangular; inner margin set with two or three spines on its distal portion; behind these are one or two tubercles; outer margin slightly raised and a little uneven. The hand is much broader than the carpus. The palm is slightly granulose under the lens. The pollex is roughened by a few large granules. The outer margin of the dactyl is armed with comparatively large, blunt teeth. Part way between this border and

the prehensile edge is a row of granules. Between this row of granules and the margin the surface is deeply concave.

Ambulatory legs moderately stout. From the upper distal margin of the carpal joints there is a small spine extending forward over the propodus. The dactyls are long and thin, but little curved.

Color in alcohol white.

California.

Eupagurus mexicanus.

Anterior portion of carapace much longer than broad. Median projection of the front sharp and but little in advance of the lateral, which are angular and each armed with a very small spine below the margin. The eye-stalks are long and nearly straight. The cornea is a little dilated. The eye scales are long, pointed, and deeply concave. The acicle does not reach the end of the eye.

The large cheliped is as long or longer than the ambulatory legs; longer in small specimens, and about the same length in large. The merus is compressed and glabrous; a small spine occupies the lower anterior outer angle. The carpus is sparsely granulose, otherwise glabrous. The inner border is raised, thin, and uneven. There is no ridge or marking of any kind separating the upper from the outer surface. The lateral surfaces are connected below by a straight ridge. The hand is thick and but little wider than the carpus. The proximal inner angle of the upper surface is minutely granulous. The granules become gradually larger diagonally across the palm to the pollex. The lateral margins of the palm are not thinned out as in related species, but are marked by a row of oblong granules. Two rows of coarse granules with a sulcus between mark the outer surface of the dactyl.

The left cheliped is very weak and small, just reaching the margin of the large hand, and no stouter than the ambulatory legs. The carpus is much compressed and has a double crest. The hand is semicylindrical; its vertical face is not equal to its horizontal.

The ambulatory legs are slender. The dactyls are thin, straight, but curve near the nail, and are spinulose below. The large cheliped is red in alcoholic specimens, becoming lighter or white towards the tips of the fingers. The ambulatory legs are a little lighter shade than the chelipeds, becoming lighter at the joints, and with a band of light color about the middle of the dactyl.

Gulf of California.

Eupagurus roseus.

Anterior portion of carapace a trifle longer than broad. Median projection of front, an obtuse angle produced but little beyond the lateral projections, which are also angular. The eye-stalks are moderately stout, constricted in the middle. The eye scales, like others of the group, are long, narrow, and pointed, with a groove on the upper surface. The peduncles of both antennula and antenna are longer than the eye, while the acicle is a trifle shorter.

The merus of the right cheliped is trihedral. The upper surface of the carpus is triangular and granulose; outer margin slightly upturned; inner margin armed with six or seven long slender spines, curved and projecting forward. The hand looks solid and smooth to the eye, but with a lens the surface is seen to be finely and beautifully granulated. The crest is not spiny, but is composed of oblong flattened tubercles, even in height and regular. The lower margin is finely bordered by granules. The dactyl is short and stout; surface evenly rounded at the margin, which is hardly apparent, but yet marked by an inconspicuous line of small granules. The lower surface is about as the upper.

The ambulatory legs are moderately stout. The dactyls are straight and armed with spinules.

There is a wide band of orange near the base of the eye-stalk and on the antennal peduncle at the base of the acicle. The hand is a light pink, while the carpus is a much darker shade of the same color. The ambulatory legs are banded with orange.

The single alcoholic specimen from which the description was made was taken in the Gulf of California by the steamer *Albatross*. The left hand was lost.

Eupagurus corallinus.

Median projection of the front rounded, much produced beyond the lateral. Lateral projections rounded, unarmed. Eye-stalks largest on the distal end; corneæ dilated. The eye scales are sharp-pointed, with prominent subterminal spines. The antennular and antennal peduncles are much longer than the eye, and the acicle is a trifle shorter.

The merus of the large cheliped is compressed, its lateral aspect quadrilateral. The carpus is a little longer than the palm; its upper surface is thickly set with very sharp spiny granules; the margins are defined by rows of spiny granules. The hand is fringed with spines alternately large and small, the spines becoming longer towards the apices of the fingers. The entire upper surface is thickly set with very small, slender, sharp spines. The spines along the fingers are very much enlarged in the center and constricted at the base.

The merus of the left cheliped is much compressed. The carpus is compressed and surmounted by a double row of spines; in the outer row, large; in the inner, small. The hand is wide and thin; fingers gaping at the base; entire surface covered with very small sharp granules. The carpal joints of all and the propodal joints of the anterior pair of ambulatory legs are crested with spines, a little large in proportion to the size of the animal. The dactyls are wide, thin, curved, and spinulose.

Color.—The meral and carpal joints of the large cheliped are blotched with red and white, while the small cheliped and the ambulatory legs are banded with the same colors.

Off Key West, Florida.

Eupagurus coronatus.

Anterior portion of the carapace very convex. Median projection of the front very sharp, and produced beyond the line of the lateral projections. Lateral projections rounded and armed below the margin with a sharp spine. Eye-stalks long, stout at the base, tapering forward to near the cornea, where it is slightly enlarged. Eye scales short, rounded, with sharp subterminal spines. Peduncles of antennula and antenna longer than the eye. Flagellum of antenna hairy; hairs long and fine. Acicle much shorter than the eye.

Merus of the large cheliped compressed, short, with a thin subserrate crest on its upper margin. The carpus is also short, stout, and with a similar crest. There are two prominent spines near the inner angle, also one or more hooked spines on the inner surface. The hand is very short, suboval. It is bordered all around with sharp teeth, separated by rounded sinuses. In the larger specimens these teeth number about thirty. The surface of the hand is minutely granulose.

The left cheliped is very small, almost rudimentary. The hand does not widen out, nor are the fingers gaping as in the other species. The dactyls of the ambulatory legs are short, flattened, spinose.

This species is widely separated from the preceding species of the same group by the very short and crested merus and carpus of the large cheliped, and by the eyes and other characters.

Gulf of California.

Eupagurus varians.

Median projection of the front pointed, produced much beyond the line of the lateral projections. Lateral projections angular. The eye-stalks are stout, constricted in the middle. Cornea much dilated, flattened. The eye scales are broad at the base, rapidly becoming narrower, and then drawn out to a fine point. The surface is much hollowed out in the distal half of its length. The subterminal spine is comparatively very long and stout, and is situated just inside of the point of the scale. The long terminal article of the antennula extends beyond the eye its entire length. The peduncle of the antenna is also much longer than the eye. The acicle is about the same length, or a little shorter. The flagellum of the antenna is hairy. The hair is long and scattered.

The merus of the right cheliped is compressed, slightly crested, and is produced down to an angle or tubercle. The carpus is long, narrow at the proximal end, widening slightly toward the manus; sides and lower surface rounded; upper surface not well defined, covered with short conical spines. The hand is fringed all around with spines varying greatly in size. The upper surface is covered with sharp, pointed granules, which are much constricted at the base and readily detached. In many specimens the hand is suboval, but in large specimens the fingers are lengthened and crossed at the tips.

The left cheliped has its merus and carpus compressed, the latter bicristate. The hand is thin and wide. Fingers gaping at the base.

The ambulatory legs are long, much compressed. Carpal and propodal joints crested with slender spines. The dactyls are thin, wide and spinulose.

Gulf of California.

Eupagurus cervicornis.

The anterior portion of the carapace is very convex, glabrous. The three projections of the front are angular, the median in advance of the lateral. Eye-stalk moderately long and stout. The scales are sharp pointed, broad at the base, and concave. The subterminal spine is prominent. The ultimate joint of the antennula is long and hairy. The peduncle of the antenna is long. The flagellum is sparsely set with long hair. The acicle is rounded, slender, and reaches a little beyond the tips of the eyes.

The right cheliped is large in proportion to the size of the body. The merus is much compressed; its depth is about equal to its length; the lower margin is rounded. The carpus is very narrow at its proximal end and widens out to the manus. The inner margin is marked by a row of conical spines. Some of these spines are red, others white. The points are sharp, and hook forward. The surface is thickly set with spines of the same shape and color but smaller. The outer margin is marked by a row of still smaller spines of the same character. The carpus is deep, running down to a point or tubercle. The tip of this tubercle in the specimen in hand is a red spine, surrounded by a circle of six or seven white spines. Outside of this circle are numerous granules. The upper surface of the hand is suboval, and is entirely fringed with spines. Those of the outer side are to some extent alternately large and small, while those on the inner border are more uniform. The upper surface is set with sharp granules, interspersed with small spines. The lower surface is evenly granular. Two protuberances on the lower surface of the hand hold the carpus firmly when the hand is drawn down. The prehensile edge of the dactyl is armed with numerous small sharp triangular teeth.

The left cheliped is very small and weak. The merus is much compressed. The carpus is compressed and surmounted by a double crest of spines. The hand is thin and oval.

Ambulatory legs compressed. Carpal joints crested with small spines. Dactyls wide, thin, and spinulose. Color pink in alcohol.

This species is found in a coral which has grown up around the original shell, and usually has a number of branches not unlike a horn of a deer. When the animal is withdrawn, only the oval face of the large hand can be seen.

Gulf of California.

Subgenus **LIBIDOCHIRUS.**

Eupagurus parvus.

Anterior portion of carapace a little longer than wide. Front with three lobes nearly equally advanced. Eye-stalks long and straight. Scales short, rounded. Subterminal spine long, slender. Acicle of the antenna shorter than the eye, much curved, hairy. Peduncle of antenna reaching but little beyond the eye. Flagellum short, reaching but little beyond the carpus of the right cheliped.

Merus of the right cheliped slightly compressed, rugose, hairy. Carpus long and slender; inner border spiny; upper surface rugose and hairy. Hand long, much swollen from the carpus to the base of the fingers, reminding one somewhat of the hand of *splendescens*. Including the marginal rows there are six rows of short spines. Spines of the intermediate rows thinly set. Long silky hairs arise from their bases.

Left cheliped much smaller than the right. Carpus slightly bicristate. The hand is much like the large hand. Fingers gaping.

Ambulatory legs slender, hairy, unarmed. Dactyls thin, curved.

Gulf of California.

Subgenus **EUPAGURUS.**

Eupagurus hispidus. *

Median projection of the front pointed and slightly produced. Eye-stalks long and stout. Scales large, triangular. Acicles of antennæ much shorter than the eye-stalks. Large hand semicircular; the inner margin of manus and dactyl straight. Behind the gape of the fingers is a very large and much elevated tubercle. Behind the tubercle are two deep depressions or pits. Outside of the tubercle are three or four tubercles of smaller size, giving the hand a deeply eroded appearance. The left hand is small. A deep depression occupies a part of the space behind the gape. The outer margin is tuberculate. The upper surface of both hands is coarsely granulate; granules elevated and much crowded.

Off Havana, Cuba.

* This species did not come to hand in time for proper arrangement.

DESCRIPTION OF TWO APPARENTLY NEW FLYCATCHERS FROM COSTA RICA.

BY

GEORGE K. CHERRIE.

Ornithologist, Museo Nacional de Costa Rica.

A single specimen before me seems to be intermediate in many characters between the genera *Mionectes* and *Leptopogon* as defined by Salvin and Godman in their Biologia Centrali-Americana. But from the rather close general resemblance (of the lower parts especially) to *Mionectes assimilis*, and the very small feeble rictal bristles, it is probably best placed with *Mionectes*.*

The third, fourth, and fifth primaries are longest and nearly equal; second equal to the sixth; first shorter than the longest secondaries.

For this apparently new Flycatcher I propose the name

Mionectes semischistaceus sp. nov.

Type: Adult female (No. 6432,† Museo Nacional de Costa Rica, Guayabal, Costa Rica, February 24, 1891; C. F. Underwood). Above, whole head, neck, and upper back, including scapulars and lesser wing-coverts, slate-gray, perhaps a little darker on the head; lower back, rump, and upper tail-coverts deep olive-green, the transition from the slate-gray to the olive-green rather abrupt. Wings and tail blackish or dusky edged with olive-green, that on the wings having a slightly yellowish or ochraceous shade. Below, chin, upper throat, and sides of head slate-gray, ligher than the back; breast olive-greenish, with a decided shading of orange-ochraceous, the latter color deepening and the former fading and disappearing posteriorly on the sides, belly, and crissum; the center of the abdomen is almost clear ocher-yellow. Under wing-coverts orange-ochraceous.

Length (skin), 5.06″; wing, 2.35″; tail, 2.13″; tarsus 0.60″; gonys, 0.26″; width of bill at nostrils, 0.20″; the maxilla is broken away close to the nostrils.

The only species of *Leptopogon* or *Mionectes* with which I have had opportunity to compare directly are *L. pileatus*, *M. assimilis* and *M. olivaceus*.

*Without doubt correctly referred to *Mionectes*, and a very distinct species.—R. R.

†No. 124616, U. S. National Museum, by the courtesy of the Costa Rica National Museum.

I have two specimens from the southwest coast of Costa Rica (Pozo Azul) that do not seem referable to any of the species of which I find descriptions, of either the genus *Ornithion* or *Tyrannulus*. I say of either genus, because the two genera seem to me very closely allied and the birds in hand might probably be referred as reasonably to the one genus as to the other. However, the bill in *T. brunneicapillus* (the only species which I have to compare with) is heavier, deeper, and not so broad at the base. The examples before me have the nostrils placed in the middle of a membrane and the rictal bristles only very feebly developed; wing rather short, somewhat rounded; tail square.

Ornithion pusillum subflavum subsp. nov.

Type: Adult female (No. 5980,* Museo Nacional de Costa Rica, Pozo Azul, Costa Rica, May 8, 1891; C. F. Underwood). Above ashy or dusky olive-green, cap dusky blackish, loral region, line on upper and lower eyelids, malar region, and anterior part of auriculars ashy whitish; a blackish spot (same color as crown) behind the eye. Wings and tail dusky; greater and middle wing-coverts tipped with olive-yellowish, forming two rather conspicuous bars, secondaries edged externally with pale yellowish. Rectrices narrowly tipped with pale yellowish. Below, chin and upper throat ashy-whitish, darkening on the lower throat and breast into olive and yellowish. Belly and crissum bright primrose yellow. Under wing-coverts primrose yellow. Inner edges of primaries and secondaries whitish, with a yellowish shade on the latter.

Length (skin), 3.66; wing, 1.90; tail, 1.64; exposed culmen, 0.33 tarsus, 0.58.

The second example (No. 5979, Museo Nacional de Costa Rica, Pozo Azul, Costa Rica, May 9, 1891), is a male in moulting plumage, the rectrices just appearing beyond their coverts. The wing and tail feathers are more blackish and the plumage as a whole fresher and brighter.

Museo Nacional,

San José de Costa Rica, September 2, 1891.

* No. 124617, U. S. National Museum. This bird comes very close to *O. pusillum* Cab., from Panama, but is much more distinctly yellow underneath, and should, I think, be separated as a local race or subspecies.—R. R.

A MAID OF WOLPAI.

BY

R. W. SHUFELDT, M. D.

(With Plate I.)

With the present paper is presented an excellent picture of a girl about 15 years of age, belonging to the pueblo of Wolpai in northwestern Arizona. She is in her everyday costume, and was photographed on one of the streets of her native city. At her hand are several pieces of their curious pottery. Nowadays the life led by one of these girls is full of all that is most engaging to the ethnologist. Prayed over at birth, she must have her delicate baby skin well rubbed with fine wood ashes, or else her bones might become loose as she grows older. Very soon she is strapped in her portable cradle, and toted about upon her mother's back, but while in the house must, in the same apparatus, be either stood up against the wall, or even hung up, where for an hour or more together, in either situation, her sole amusement consists in peering about the "living room." As soon as able to walk, this little child is permitted to toddle about everywhere or ascend and descend the house ladder before the second summer has passed over her head. She has no end of toys and other playthings to amuse her. From 3 on to 7, or perhaps a year or two more, her days are spent mostly in romping and playing with the numerous other children in the pueblo. Innocent of all clothing and possessing a wholesome dread of water for any other purpose than to drink, she is at this age as wild as a mountain sheep, and can with almost equal celerity run up and down the steep, rocky crags that so abruptly slope down from the pueblo on all sides save one.

Becoming more sedate after her tenth year, she now assumes the garb of her elder sisters, or the companions of her own sex, and with a keen interest commences her early education in those accomplishments which soon render her a useful member of the tribe. Very soon she is quite familiar with all the duties that pertain to the kitchen, and as Capt. Bourke pointed out, "is duly instructed at this tender age in the fabrication of pottery and basket work." As she grows stronger, the operation of carding and dyeing wool and the weaving of blankets, mantles, petticoats, garters, and sashes of cotton or wool. By the time she is 15, or even at an earlier age, she is considered nubile, and

fairly entered in the matrimonial market. She can bake, sew, dye, card, weave, and spin; her nimble fingers fashion the plastic clays into every shape needed for use or ornament; the tender shoots of the willows or the pliable roots of the grasses respond to her fairy touch and round themselves into beautiful baskets, vivid with coloring and repeating the sacred emblems of the butterfly, deer, or thunder-bird.

In the number of stews, ragouts, and broths which she knows how to compound of the flesh of the kid or sheep, and such vegetables as the onion, bean, and aromatic chile; or in the endless diversity of hominy, mush, pop corn, and piki bread, she will hold her own with the most ingenious American housewife.

The most striking feature about the girl in our plate is the manner in which she does up her hair. This is the custom of the young unmarried women, for the Wolpai maiden considers herself a woman grown at 15. They accomplish this remarkable feat in the toilet by wrapping their hair over some pliable switches of either willow or cottonwood, which latter have been previously wound round with blue yarn to keep them in place. Then next her head, the base of the whorl is also wound around to keep the whorl in proper shape. She also parts her hair in the middle, and wears two heavy locks, one over each temple, which hang down and are cut square off below, on a level with the nostrils. This girl as will be seen has quite a pretty face, and the great whorls of hair over her ears at the side of her head, are after all not so very unbecoming.

The hair is done up with especial care on all gala days, and upon such occasions in Moqui, Bourke says, "the young maidens of the villages were out in full force, decked in the most gorgeous finery of native manufacture, their freshly cleaned tresses of raven black were done up in flat, circular coils one over each ear, the general effect being to make them resemble the Chinese."*

In another place of the same work just quoted (pp. 117, 118), Bourke adds to the above statement that the "Moquis call themselves Hopii or Opii, a term not now in the language of everyday life, but referring in some way to the pueblo custom of banging the hair at the level of the eyebrows. This mode of wearing the hair distinguishes them from the Apaches, Utes, and Navajos, and, as Lochi wished me to bear in mind, showed that they were once 'todos los mismos' with the Mohaves, Yumas, Maricopas, and other bands of Arizona, whose practice of banging the hair is in such curious contrast with the loose, unkempt manner of wearing it peculiar to the Apaches. Now among numerous photographs of girls of Moqui and Wolpai none of them have the hair banged across the level of the eyebrows, but it is invariably arranged

* Snake dance of the Mokis, p. 114. That these coils are flat is an error quite commonly made, and that they are not always so may be seen from the plate in the present paper. All the published figures ever seen by the writer of the young unmarried Moqui women have the coils too small, too flat, and altogether too much like circular disks of wood.

and cut as shown in the plate illustrating this article; moreover, the same remark applies to photographs of groups of these girls taken in the snake dance of August, 1889.

The right is reserved to the girls of all the Moqui pueblos to choose their own husbands and probably also to divorce themselves from the same, in case they discover they have made a mistake in any particular instance. Daughters also inherit their mother's property. After marriage the Wolpai matron ceases to wear her hair in side-whorls, but, parting it in the middle, clubs it behind into a queue much after the fashion of the men. She may or may not bang it in front at the level of the eyes, and as whim seizes her she may occasionally part it to the right or left side.

During the snake dance and in full costume it is the business of these Wolpai maids, as well as the matrons, to sprinkle the corn meal. This they do most effectually on the snakes, on the dancers, on the ground, and indeed in nearly all other directions. They are never allowed, however, to handle the snakes, a privilege enjoyed only by the men.

Monogamy is the rule among the Pueblo Indians, and they do not obtain their wives through purchase. Indeed, in the household, the woman reigns supreme, and the man has but little to say. Among the Zuñis a purchase can not be made within doors unless it is by the consent of the wife, and the same holds true among the Moquis.

Taking it all in all, then, the life of a Wolpai woman is by no means an unhappy one; indeed, from her babyhood to maturity it is filled in with many pleasurable chapters, and no doubt a great deal of this is due to their contented dispositions, and their love of home life, and their untiring industry.

A MAID OF WOLPAI.

CONTRIBUTIONS TOWARD A MONOGRAPH OF THE NOCTUIDÆ OF BOREAL AMERICA—REVISION OF THE GENUS CUCULLIA.

BY

JOHN B. SMITH, SC. D.

(With Plate II.)

CUCULLIA Schrank.

1802. Fauna Boica, II, 2, 157.

Eyes naked, fringed at the margins with rather short hairy lashes, quite variably distinct and sometimes feeble. Tongue long and strong. Head large, not prominent, somewhat retracted. Front smooth, vestiture even, woolly. Palpi moderate, scarcely exceeding the front in the males, usually reaching the middle of front in the females. Antennæ simple in both sexes, except in *serraticornis*, in which the joints are laterally produced and bristled in the male. Thorax stout, quadrate, collar greatly developed, in perfect specimens forming a sharp keel and projecting hood-like over the head. Vestiture consisting of long, flattened hair. Patagiæ distinct. A variable, never prominent, posterior tuft. Legs moderate, stout, well clothed with hair and scales, not spinose. Abdomen long, conic, much exceeding secondaries, with a series of dorsal tufts very prominent and distinct in *convexipennis*, moderate only in all our other species. These tufts are easily dislodged, and specimens otherwise perfect may be deficient here. Primaries comparatively small, narrow, with acute apices, lanceolate or nearly so. Secondaries proportionate to primaries, small as compared with the body; a slight excavation in the outer margin opposite the cell.

The species are comparatively few in number, and I am inclined to believe that most of them are known. The high western plateaus and the Pacific coast may yet yield a few additional species, but not many, I think. They are closely allied and yet not difficult to separate when care is taken, because there is little variation, and small characters prove constant in large series.

The narrow, lanceolate primaries, hood-like collar, and long abdomen, combined with the lashed eyes and unarmed legs, make the genus an easily distinguished one.

The species, except *convexipennis*, are very similar in color, all of some shade of ashen gray, sometimes with a brown suffusion. In all, the

veins are more or less obviously black-lined, and there is a strigate appearance, varying in degree. The ordinary lines are never complete, and the t. a. is often wanting altogether except in the submedian interspace. No detailed reference is made in the descriptions to these common characters, more emphasis being put on those characters which really distinguish the species.

A few only of the forms are really common; but some species, usually not represented in collections, are undoubtedly missing because their distinctness has not been recognized. *Postera* and *florea* as distinct from *asteroides* are examples, and probably the three will be found to have the same distribution.

The t. a. line is, in most of the species, traceable in the submedian interspace, where it forms a long outward projection or tooth, nearly reaching the middle of wing. Quite usually, where this is discernible, there is also a fine, black longitudinal line from the base to the end of this tooth. At first sight this outline has a strong resemblance to a claviform; but in the few species in which that feature is found, it is attached at the end of the tooth and reaches the t. p. line. Usually this same line is again marked on the inner margin by a black dash or line extending outwardly.

It is quite notable that we have no species common to both sides of continent, but that, except *convexipennis*, every one of the eastern species has a close ally in Colorado. Thus *asteroides*, *postera*, and *florea* are represented by *montanæ*, *similaris*, and *obscurior*; *speyeri* and *intermedia* by *dorsalis* and *cinderella*. *Serriaticornis* is the only Californian form known to me, though Dr. Behr has named a *C. solidaginis* which can not be recognized from the description.

Lætifica is from Arizona and Texas, and is the only southwestern form known to me.

Easily distinguished from all the other species known to me is *serraticornis*. The antennæ in the male are distinctly toothed, the lateral processes furnished with a bristly tuft. This character is a remarkable one for the genus, and is accompanied by an equally divergent sexual structure. Should the species find strictly congeneric allies it may be eventually separated from *Cucullia*. In color it is ash gray, quite strongly resembling a small *speyeri*, or yet more nearly a small *lætifica*. I have seen no female, and Dr. Lintner in his original description had only males before him. As already stated, it is the only Californian species known to me.

Of the species with simple male antennæ, *convexipennis* differs in color from all the others. Through the center of the primaries the shade is a peculiar yellow ash-gray; from the middle of the costa to the outer margin at vein 4, a leather-brown shade suffuses the wing and darkens decidedly toward costa. A similar shade extends from the middle of the inner margin to the outer margin at vein 3, cut by the pale s. t. line, which is elsewhere marked on the costa only.

The abdominal tufts are larger, more dense and more prominent than in any other of the species, and are of a rich brown with a carmine admixture.

The balance of the species offer no unique characters, and are separable into two series, containing quite closely related species. In the first of these series the t. p. line is marked in the submedian interspace by a lunate pale line, preceded and followed by a dusky or black line or shade. In the second series the t. p. line is black or dusky, single, toothed in the submedian interspace, and without the pale lunule. In none of our species is it at all questionable to which series it is referable.

The first series contains six species, all with the same type of maculation, and closely related. The sexual characters are practically alike, and offer little aid in separating species. The harpes are long, quite narrow beyond the middle, somewhat widening to the oblique tip, which is acute at the superior angle, and inwardly fringed with spinules. The clasper is single, stout, short, arising from a broad corneous base, extending obliquely outward and upward, and rarely exceeding the lateral margin of the harpe. The exceptions to this type are exceptional in other characters, and are aberrant as members of this genus.

Three of the species are western—Colorado and Montana—and as a whole they differ from the three corresponding eastern species by the usually more distinct maculation, and by a peculiar roughness in vestiture, the eastern forms being quite smooth and even. There is a tendency in all the species to a dotted maculation of the ordinary spots, two round dots in the orbicular and four in the reniform being normal.

Montanæ is the best marked of all the species. It is gray in color, the basal space yellow, a deeper shade extending through the cell and beyond it to the outer margin. In the median space the costal region is very dark gray. Beyond the lunule the submedian interspace is also yellow brown, with a darker, sometimes blackish, curved streak. The ordinary spots are large, well defined, paler in color, with the brown dots usually distinct. The secondaries are white at base, with a well-defined outer dark band, broader in the female.

Similaris has exactly the same maculation as *montanæ*, but lacks all the yellow shadings. The costal region is darker gray, and there is a blackish shade along the internal margin. Beyond the lunule in submedian interspace there is a distinctly defined curved black streak. The ordinary spots are very distinct and the defining lines are broken into dots, much as in the European *absynthii*. The secondaries are whitish at base, darkening outwardly to blackish, without having a defined band, as in *montanæ*. I consider the species a fairly distinct one, and have both sexes.

Obscurior is another species of the same series; but it is very dark gray, even in color, with the markings ill defined. The ordinary spots are as in the preceding; but not at all distinct. The secondaries are fuscous, slightly paler only, toward base. I have females only.

The three eastern species are as closely related as are the western; but diverge in a somewhat different way, so that they are less nearly allied to each other than to some of the western forms.

Asteroides is the eastern representative of *montanæ* without the distinct maculation, and without the yellow coloring at base of primaries. It has the same costal shading and the same markings beyond the lunule in submedian interspace. The ordinary spots are much less prominent, and the contained dots are vague. The secondaries are whiter, the marginal shade better defined and narrower.

Postera is much more intensely colored, much darker bluish gray, and the brown shading is much deeper. All the markings are much more distinct. The secondaries are smoky fuscous, only a little paler basally. Both sexes agree in these characters, and the species has no exact representative in the western series. It is nearest to *obscurior*, but is yet nearer in appearance to the European *asteris*.

Florea averages smaller in expanse than the preceding species, and is more gray without the brown shadings. The ordinary spots are fairly distinct, the orbicular smaller and more irregular than in any other of the series. The secondaries are whitish fuscous at base, darkening to smoky outwardly, intermediate in this character between *asteroides* and *florea*; but differing from both in the primaries. This species stands nearest to *similaris* in the western series. There is no apparent difference between the sexes.

The second series also contains six species, as a whole as closely related as those of the first. They have a type of sexual structure which, except in *bistriga* does not differ essentially from that of the preceding. The harpes are perhaps somewhat more parallel and the tip is not so acute superiorly. The clasper is rather longer, more slender, acute, and in *lætifica* and *speyeri*, curved, hook-like.

Four of the species have the secondaries white at base, with a fairly well-marked smoky or blackish outer margin.

Lætifica is the palest of the species, the dusky margin of secondaries very narrow in the male, much more distinct and broader in the female. The t. p. line sends a rather narrow loop-like tooth, rounded at tip, into the submedian interspace, the black streak beyond it reaching into the sinus to the line itself. Preceding the sinus is an indefinite white patch (the claviform), always distinct in the males, but much less obvious and sometimes wanting in the females. The latter are also darker as a rule. These points are characteristic of the species and are found in none other known to me. *Cita* Grt. and *hartmanni* French, are synonyms.

Speyeri is a larger and somewhat darker species, much the same in general type of marking. It lacks the white patch preceding the sinus of the t. p. line, and the sinus itself is very different, being rather a broad tooth or angle, broken in its course by a small tooth in the line to the apex of the angle. The curved streak to outer margin does not extend

to the end of the angulation, which is acute at tip. The thoracic dorsum is dusky.

Dorsalis is very like the preceding and is its western representative. It differs in the clearer gray color without fuscous admixture and the dorsum of thorax is concolorous and not darker.

Bistriga is an intruder here, and may eventually, if it finds allies, get another genus. It is smaller than any other of the species and the abdomen does not much exceed the secondaries. In other characters it does not differ essentially, and a new genus would be premature. It is a rather even gray, somewhat coarsely black-powdered along the costa. There is a distinct black streak along inner margin from base, and another broader streak from the t. a. line to outer margin through the submedian interspace. The secondaries have the dusky outer margin much less definite, and as a whole the species can not be mistaken.

The remaining two species have the secondaries smoky fuscous, and the primaries deep bluish ash-gray.

Intermedia has the median lines indicated on the costa, and generally traceable, sometimes distinct, for the remainder of the course. It is an eastern species.

Cinderella is smaller, the forewings narrower, more pointed, and immaculate save for a series of terminal black lunules, preceded by short black lines. It is from Colorado.

This last species, at first sight, looks doubtful, and yet I would be surprised if even large material proved it a form of *intermedia*. In a genus in which the species are less closely related I would not have described it, nor would I have described it at all save in a revision like the present, where its position and rank can be compared and such differences as exist brought out. The genitalia closely resemble those of *intermedia*, but are noticeably different, and emphasize the probability of specific distinctness.

The present revision is based very largely on material received from the U. S. National Museum through the courtesy of Dr. Riley, the honorary curator, and all the old species are represented in that collection. I have added all the species described by myself, so that of the known species the Museum contains a full series. The species described as *luna* by Mr. Morrison is an *Heliothid*.

I have seen the types of *postera* and *florea* in the British Museum, so that I am certain of the correctness of the identification of these species.

To Dr. J. A. Lintner I owe thanks for a copy of his Entomological Contributions, No. III, containing two photographic plates of *Cucullia*, European as well as American. The plates are among the finest of their kind known to me, and the species are distinctly and clearly shown in all the details of maculation. Dr. Lintner there points out some of the relationships of our species to European forms, and his paper should be consulted on that point. To Mr. Bruce I owe a fine series of Colorado

material, which has enabled me to describe the species of that region and compare them with the eastern forms. Mr. Neumoegen kindly loaned me such specimens as I needed for comparison from his fine collection.

In tabular form the arrangement of the species would be as follows:

1. Antennæ simple in both sexes.....2
   Antennæ of male serrate, brush-like.....9
2. Bright luteous gray; a yellow brown shade extends outward from middle of costa to outer margin at vein 4; a similar shade from inner margin near base to outer margin at vein 3.....CONVEXIPENNIS
   Ash gray with a bluish tinge. T. p. line distinct in submedian interspace, where it forms a pale lunule, preceded and followed by a blackish line and shade; a curved streak or shade also extending to the outer margin.....3
   Ash gray, variable in shade. T. p. line variably distinct, single, black, never forming a pale lunule in submedian interspace.....6
3. Western species: Colorado, Montana.....4
   Eastern species.....5
4. Costal region much darker, suffused with a dull yellow shade; base yellow; curved shade over anal angle diffuse, yellow-brown.....MONTANÆ
   Costal region scarcely darker, without yellow shade; base not yellow; curved marks over anal angle black, sharply defined.....SIMILARIS
   Costal and inner margin dusky; color darker blackish gray, maculation all obscure.....OBSCURIOR
5. Secondaries white with a broad outer dusky band. Costal region much darker, with a dull yellowish tint.....ASTEROIDES
   Secondaries dusky fuscous, basally somewhat paler.
   Primaries dark slate gray, costal region darker, with a brown suffusion.
   POSTERA
   Primaries paler, ashen gray, costal region somewhat darker, but without a brown suffusion.....FLOREA
6. Secondaries white at base, with a fuscous outer margin, narrow in the ♂, wider in the ♀.....7
   Secondaries smoky fuscous, only a little paler at base.....8
7. Paler ash gray; inward tooth of t. p. line in submedian interspace single, narrow, rounded at tip.....LÆTIFICA
   Darker gray; inward tooth of t. p. line in submedian interspace double, broadly open outwardly, the tooth acute at tip.
   Dorsum of thorax dusky; habitat eastern.....SPEYERI
   Dorsum of thorax concolorous; habitat western.....DORSALIS
   Rather dark ash gray; a distinct black streak along inner margin to t. p. line, and a broader streak through submedian interspace from claviform to the outer margin.....BISTRIGA
8. Size larger, median lines vaguely traceable; habitat eastern.....INTERMEDIA
   Size smaller, all maculation wanting; habitat western (Colorado).....CINDERELLA
9. Maculation vague, color gray; habitat California.....SERRATICORNIS

Cucullia convexipennis G. & R.

1868. Grt. and Rob., Tr. Am. Ent. Soc., II, 201, Pl. 3, Fig. 76, *Cucullia.*
1869. Beth., Can. Ent., I, 86, *Cucullia.*
1874. Lint., Ent., Cont., III, 138, 170, *Cucullia.*

Head brown with a carmine tinge, palpi paler in front, two little white-tipped tufts between the antennæ. Collar with narrow black,

broader white, and still wider brown transverse lines; a double set of each. Thorax with patagiæ gray, with brown powderings and brown margins. The dorsal tufts are very distinct, thick, and brown, continued without break on the dorsum of the abdomen. Primaries gray, with a yellow-brown shading through the center of the wing. Basal and t. a. lines marked as short brown dashes on the costa, the latter with the long median tooth traceable. The median shade line is marked by a distinct brown line from the middle of costa, outwardly oblique over reniform to the middle of the cross vein of cell. Beyond that along costa, and to vein 4 on the outer margin, the wing is shaded with leather brown, darker at the margins. T. p. line marked by a geminate black line crossing costal region, the intervening line pale gray. From this gray line a gray streak extends outwardly to outer margin between veins 6 and 7, and curved upward to the apex of the wing. The veins through this darker brown shade are pale marked, and there are four more or less distinct gray costal dots. A double blackish line with brown interspace extends along inner margin from near base to t. p. line. The t. p. line becomes obvious in the submedian interspace as a narrow pale line with brown defining margins. It is slightly curved to the submedian vein, and thence makes a long inward bend to the hind margin. From this point a leather-brown shade extends obliquely to the outer margin, which it reaches on vein 3. Thence the shade extends narrowly along the margin, connecting with the costal shade. On veins 3 and 4 a white line cuts the fringes. Fringes with a pale yellow line at base, a blackish central line, and broader, dull gray outer shade. Orbicular reduced to two small black dots. Reniform indicated by from two to four dots, indicating the upper margin. Secondaries yellowish white at base, with a broad fuscous outer margin, narrower in the male. Veins dark marked. Fringes yellow at base, white tipped. Beneath smoky, primaries darker, paler toward base along inner margin. Secondaries paler, whitish basally.

Expands 45 to 49 millimetres=1.70 to 1.95 inches.

HABITAT: Canada; New York, Sharon Springs (in July), Long Island; New Jersey; Pennsylvania; Northern, Middle, and Eastern States.

The species is a strongly marked one, and has been already sufficiently compared with others. It does not vary to any appreciable extent, so far as I know.

The harpes of the male are elongate, narrow, widening at tip, which is oblique, the upper angle produced, margin inwardly fringed with spinules. The clasper is quite close to base, and is a single, nearly straight, corneous process, quite slender, and terminating acutely. It exceeds the lateral margin of the harpe by one-third its own length.

Both sexes are in the Museum collection.

Dr. Lintner has described the larva on *Solidago*.

Cucullia montanæ Grt.

1882 Grt., Can. Ent. XIV, 175 *Cucullia.*

Head blackish gray, front with black and pale transverse lines; palpi paler in front. Collar inferiorly luteous shaded, else rather pale, ash gray, with several indistinctly marked transverse lines and a black tip. Patagiæ pale gray with a few prominent black scales intermixed. Dorsum of thorax dark brown, as are also the distinct abdominal tufts. Primaries bluish ash gray with a broad costal region washed with yellow-brown, darker in the median space. Base yellow, shading into the ground color half way to the t. a. line. T. a. line in most cases distinct through the dark costal space, traceable over the long median tooth and distinct again on the hind margin along which also a blackish gray shade extends. T. p. line pale through the dark costal space, very faint or wanting through the center of the wing, distinct as a pale incurve margined by blackish, in the submedian interspace; thence from vein 1 to internal margin, inwardly oblique. A dusky shade precedes the pale lunule, and a yellowish-brown shade extends beyond it to the outer margin, superiorly marked by a darker brown streak. A series of black, terminal lunules. A more or less obvious series of brown interspaceal streaks along the course of the s. t. line. Fringes gray, cut with pale, and with a pale line at base. Ordinary spots large, well defined, usually paler, more yellow. Orbicular with two brown inner dots, one above the other, sometimes connected to form a central line. Reniform with four brown dots, sometimes partly connected; but usually distinct. Secondaries whitish, subhyaline at base, with a narrow dark outer margin, broader in the female. Veins darker marked. Beneath, primaries blackish, secondaries white, the margins broadly blackish.

Expands, 47 to 50 millimetres=1.88 to 2 inches.

HABITAT: Montana, Colorado.

Ten specimens, all of them collected by Mr. Bruce, are before me, five of them from the collection of the U. S. National Museum. They are practically all alike, varying only a little in relative distinctness of maculation. I have seen others, none offering distinctive features. It is the most distinctly marked of the species. The pale ordinary spots are prominent, and the yellow base of primaries is characteristic. The dark costal margin is powdery and the insect has a rough or "squammose" appearance. It is intermediate in some respects between *postera* and *asteroides* and, while most nearly related to the latter, is amply distinct from either.

The harpes are only moderate in length, widening basally, the tip oblique, somewhat drawn out superiorly and inwardly spinulose. The clasper is short, stout, rather obtuse at tip, from a broad chitinous base along inner margin, extending obliquely upward and forward, and not reaching beyond the upper margin.

It seems to be common and is attracted to the electric lights.

Cucullia similaris sp. nov.

Head dusky gray, with darker transverse lines. Collar pale gray, with a distinct black line at base, a less evident double line at middle, and a blackish tip. Patagiæ pale gray with a few black dots. Dorsum narrowly blackish, as are the small basal tuft and the dorsal tuftings of the abdomen. Primaries pale ash gray, somewhat darker, black powdered along the costa, but without any luteous shading or suffusion, and not yellow at base. A faint yellowish shade over the ordinary spots. A black streak along hind margin to the t. p. line. T. a. line sometimes evident through the dark costal region. The long median tooth very faintly indicated. T. p. line vaguely marked on costa, distinct through the submedian interspace as in *montanæ*, preceded and followed by a small blackish shade and followed also by a curved black streak below vein 2. A series of black terminal lunules. Ordinary spots only slightly paler, yellowish tinged, the defining lines broken into distinct black dots and streaks, four in the orbicular, six in the reniform. The orbicular has two black inner dots, the reniform four. In shape they are as in *montanæ*. Secondaries in the male whitish at base, with a moderate smoky outer border, in the female darker, more yellowish fuscous, the marginal band broader. Beneath, primaries blackish, secondaries whitish with black powdery borders.

Expands 47 to 50 millimetres=1.88 to 2 inches.

HABITAT: Colorado, Platte Canon on flowers, 6,500 feet.

This species is exactly like *montanæ* in ornamentation; but is much more even, paler gray without any of the yellow or brown shadings. The ordinary spots and their marginal rings are distinctly black dotted, much as in the European *absynthii* and the markings are black, not brown. The secondaries have the outer border less defined than in its ally, and they are darker throughout.

In sexual structure of the male there is very little difference from *montanæ*, and such as exists is better seen by a comparison of the figures herewith given.

Three specimens, 2 ♂ and 1 ♀, have been examined and no variation detected.

Cucullia obscurior sp. nov.

Head brownish gray, with pale and dark transverse lines. Collar dark blue-gray, yet darker tipped, with a distinct basal and a vague median transverse line. Patagiæ dark ash-gray; dorsum blackish, as are also the small dorsal tufts of the abdomen. Primaries dark bluish gray, with none of the maculation distinct; costal region scarcely darker, and the blackish streak along internal margin inconspicuous. T. a. line faintly indicated on costal space and on the median tooth. T. p. line indicated only in the submedian interspace, preceded by the usual blackish patch, but followed only by a curved black streak below vein 2. Ordinary spots as in *montanæ*, but vague, only inferiorly

outlined, the lines not distinct; a broken, slightly lunulate, terminal line; a pale line at base of fringes; the latter fuscous gray. Secondaries smoky fuscous, paler at base, the veins marked. Beneath blackish, powdery; secondaries a very little paler centrally.

Expands 46 to 47 millimetres=1.84 to 1.88 inches.

HABITAT: Colorado (Bruce).

Two female specimens are before me. They are entirely alike, and differ from all the preceding in the deep blue-gray primaries, in which the maculation is very indistinct, and the dark, smoky-fuscous secondaries. So far as the markings are traceable, they are exactly as in the preceding species.

At first sight, this form resembles *intermedia* more nearly; but the character of the t. p. line at once refers it here. I have no doubt the sexual characters will be found to be very like those already described.

The species is not unlike *postera* without the reddish shades.

Cucullia asteroides Gn.

1852. Gn., Sp. Gen., Noct., II, 133, *Cucullia*.
1857. Wlk., C. B. Mus., Lep. Het., XI, 656, *Cucullia*.
1874. Lintn., Ent. Cont., III, 139, 169, *Cucullia*.

Head dark-brown, with pale and dark transverse lines. Collar pale bluish gray, blackish tipped; a distinct black line at base and two vague transverse lines at middle. Patagiæ pale-gray, sometimes a little yellowish. Dorsum blackish, as are also the small abdominal tufts. Primaries a very even, smooth bluish gray; costal region with a luteous shade extending through the cell, and intensified in the ordinary spots; the costa itself yet darker, sometimes blackish. A blackish and yellow-brown shade along internal margin. T. a. line sometimes traceable across the costal space and in the submedian interspace; but more usually it is entirely wanting. T. p. line obvious only in the submedian interspace, where it forms a pale incurve, margined by blackish defining lines. This is preceded by a small dusky or blackish patch, and followed by a yellow-brown shade to outer margin, emphasized above by a blackish-brown curved streak. A broken, black terminal line. Fringes gray, with a yellowish line at base. A fine black longitudinal line extending from base of wing to the tip of the long tooth of t. a. line. Sometimes both line and streaks are obsolete. Ordinary spots large, pale, usually void, sometimes with two brownish spots in the orbicular; four in the reniform. There is no real defining line, the difference in shade between the macula and its surroundings being sharp enough for distinction; but sometimes this is intensified by brown dots. Secondaries white, with a well-marked blackish outer border, narrower in the male. Beneath, primaries smoky, secondaries whitish, with powdery margins. Expands 44 to 51 millimetres=1.64 to 2.05 inches.

HABITAT: Canada; New York, Kendall, Long Island, Albany May 30 and June 6; New Jersey, New Brunswick, May 21; Washington,

D. C., August 10; Nebraska, West Point, in May; Northern, Eastern Middle and Central States.

This is the most common of our eastern species, and it is either double brooded or the hibernating imago flies for a long period. Dr. Lintner reports the larva on Solidago September 1 and 24.

A long series of specimens, largely from the collection of the U. S. National Museum, is before me, and shows little variation. The costa is sometimes a little darker, the yellow shading sometimes more intense, the ordinary spots occasionally a little more marked; but otherwise there are no noteworthy differences. The secondaries are whiter and more hyaline than in any others of the first series, *montanæ*, its nearest ally in this particular, being quite distinctively different in maculation of primaries.

The harpes of the male are longer and narrower than in the preceding species, the tip more oblique and superiorly more produced. In type characters it does not differ in the least.

Cucullia postera Gn.

1852. Gn., Sp. Gen. Noct., II, 133, *Cucullia*.
1857. Wlk., C. B. Mus., Lep. Het., XI., 656, *Cucullia*.
1874. Lintn., Ent. Cont., III, 169, *Cucullia*.

Head dark brown, palpi paler in front, a black, followed by a pale line on vertex. Collar deep, somewhat carneous gray, with a black transverse line near base. Patagiæ deep bluish ash gray. Dorsum blackish, with a black-tipped, truncate, posterior tuft. Dorsal tufts of abdomen small, but distinct, dark brown or blackish. Primaries deep bluish gray, with a carneous tinge, costal region from base to apex suffused with brown, extending inward to the median vein. Median lines vaguely marked on costa; the median tooth of t. a. line fairly evident. T. p. line pale through the submedian interspace, preceded by a distinct, followed by a less evident black line. It is incurved to vein one, thence very oblique inwardly to the hind margin. A blackish streak extends inward along inner margin, nearly to base. Preceding the s. t. line in the submedian interspace is a small blackish or brown shade, and following it to the outer margin is a brown shade which fills the interspace and extends to the outer margin, superiorly emphasized by a black streak. A broken series of vague interspaceal dashes along the course of the s. t. line. A series of black terminal lunules. Fringes concolorous or fuscous. A fine black basal streak. Ordinary spots variably distinct, always traceable, sometimes concolorous, more usually paler. They are defined by a very narrow black line, inside of which is sometimes a broad gray annulus; in that case the center is brown. Secondaries yellowish fuscous, smoky outwardly, darker in the female, veins dark marked. Beneath, smoky or blackish, powdery, somewhat paler at the base of the secondaries.

Expands 45 to 50 millimetres=1.7 to 2 inches.

HABITAT: New Hampshire, July 21; New York, Sharon, July 7; New Jersey.

The New Hampshire specimen is in the collection of the U. S. National Museum (collection of C. V. Riley) and was taken by Dr. Thaxter. The Sharon Springs example is from Dr. Lintner's collection, taken by Mr. Meske. Two other examples before me are from New Jersey without date or exact locality. It is certain that the distribution covers the middle and eastern States, and probably it is coextensive with that of *asteroides*. With the latter species, *postera* is almost certainly confused in collections, though its deeper primaries and fuscous secondaries should readily distinguish it.

There is some variation in the relative distinctness of the markings, but none otherwise. The ordinary spots are sometimes defined only by a slight difference in shade, and sometimes by a distinct continuous line, a pale annulus, and a brown center. The little series before me shows this range, the Sharon Springs example being the best marked, though not the most contrasting.

The sexual characters are as in the western species rather than as in *asteroides* and somewhat intermediate. The differences are shown by the figures given on the plate.

Cucullia florea Gn.

1852. Gn., Sp. Gen. Noct., II, 133, *Cucullia.*
1857. Wlk., C. B. Mus., Lep. Het., XI, 656, *Cucullia.*
1874. Lintn., Ent. Cont., III, 169, *Cucullia.*

Head gray to brown, with gray and black transverse lines. Collar gray, with a distinct black line at base and a less evident dark line above middle. Patagiæ rather pale gray, black powdered. Dorsum blackish brown, contrasting, basal tufts small, as are also the dark dorsal tufts of the abdomen. Primaries rather pale ash gray, even in color, costal region only slightly darker beyond the middle, without red or brown shades. T. a. line vague, less distinct even than in *postera*. A blackish streak along the inner margin to the t. p. line. T. p. line pale marked through the dark costal region, then obsolete to the submedian interspace, where it is of the gray ground color, defined by blackish marginal lines and exactly as in *asteroides* and *postera* in course. The preceding dusky patch is sometimes wanting, but is usually fairly distinct. The following shade to outer margin is vague; but the black streak below vein 2 is distinct. The ordinary spots are distinct in all specimens, concolorous, sometimes with a dusky center, defining lines incomplete, very little marked. The orbicular is somewhat narrower and more irregular than in the other species. A series of vague interspaceal dashes indicate the course of the s. t. line. A series of small black terminal lunules, degenerating into a broken terminal line in some specimens. Secondaries soiled whitish at base, smoky fuscous

outwardly, forming a broad, not defined outer marginal band. Beneath blackish, powdery, pale at base of secondaries.

Expands 42 to 47 millimetres=1.68 to 1.88 inches.

HABITAT: New York, Sharon Springs, July 6 and 8, Newburg; Pennsylvania.

This is the smallest in average expanse of the three closely allied eastern species. Three of the specimens before me are from the U. S. National Museum (collection of O. Meske and C. V. Riley), one, from Mr. Neumoegen and the other from Dr. Lintner. This is also almost certainly confused with *asteroides*, from which it differs in the even gray color, the costa hardly darker and without reddish or brown shades. The secondaries are also much darker, with a broader outer border; but not so dark as in *postera*, from which the present species differs widely in maculation of primaries.

The sexual characters are essentially as in *asteroides*, but there is considerable difference in detail, better shown by the figure. The clasper in the specimen from which the drawing was made was turned the wrong way, and bearing this in mind its resemblance to *asteroides* is marked.

Cucullia laetifica Lintn.

1875. Lintn., in Grote's Check list, 24, *Cucullia.*
1878. Lintn., Ent. Cont. IV, 89, *Cucullia.*
cita Grt.
1883. Grt., Papilio III, 75 *Cucullia.*
hartmanni French.
1888. French, Can. Ent., XX, 69 *Cucullia.*

Head dusky gray, with pale gray and black transverse lines; palpi paler in front. Collar ash-gray with a basal black, and a median dusky transverse line. Patagiæ gray, dorsum dark brown, as are the very small dorsal tufts of the abdomen. Primaries very pale whitish gray in the male, distinctly darker, ashen gray in the female. The costal region is very little darker, the median lines sometimes indicated by darker geminate dots. T. p. line marked in the submedian interspace by a narrow black line, sending inward a long narrow sinus, rounded at tip. A narrow black line runs centrally through this sinus, broadening to a curved black streak beyond it. This streak reaches the outer margin below vein 2, and in the interspaces between 2 and 3, and 3 and 4, are usually two black sagittate marks basing on the outer margin. Preceding the end of the sinus in the submedian interspace is an indefinite white patch, representing the claviform spot. This is usually distinct in the male; but very indefinite and sometimes wanting in the female. A more or less evident black streak along inner margin near base. A fine black longitudinal line at base reaching the end of the long tooth of t. a. line, which is rather feebly marked. Ordinary spots obsolete, the inferior margin of reniform sometimes vaguely outlined. In the male there is usually

a faint luteous shade indicating the location of the spots; but this is as usually wanting in the female. A broken, black terminal line. Secondaries white, subhyaline, with a smoky outer margin, very narrow in the male, darker and a little broader in the female. Beneath, whitish, powdery, the primaries darker.

Expands 43 to 45 millimetres=1.72 to 1.80 inches.

HABITAT: Arizona; Texas, Columbus, Bastrop County April 3 to 30, Harris County.

The Arizona specimen is the type of *cita* Grt., from Mr. Neumoegen's collection. The type of *lætifica* from Bastrop County, placed by its side, discovers absolutely no difference in any feature. The description of *C. hartmanni* French fits to these specimens perfectly, and fits nothing else known to me. Seven other specimens are before me, most of them from the Belfrage material in the U. S. National Museum (collection of C. V. Riley) and show a somewhat greater range of variation than usual in the genus. There is quite a decided difference in the ground color in the sexes, the males being quite pale, while the females are sometimes nearly as dark as in *intermedia*, and look like small *speyeri*. The essential character, which is marked in all the specimens, is in the sinus of the t. p. line in the submedian interspace, and this will enable the species to be recognized in all its forms.

The sexual characters are much as in *speyeri*. The clasper is shorter and stouter, and the angles of the tip of harpes are more rounded. Otherwise there is little difference. The figure given herewith shows the clasper turned the wrong way out. It is so on the slide and the figure was made from a camera drawing. Normally it projects outward and a little upward. In mounting, the pressure applied turned the hook the wrong way and it was not noticed until too late to rectify readily.

Cucullia speyeri Lintn.

1874. Lintn., Ent. Cont., III, 168, *Cucullia*.

Head fuscous brown with gray and black transverse lines. Collar pale gray, a distinct black line at base, and a geminate brown transverse line at middle. Patagiæ pale gray, dorsum brown, as are also the rather distinct abdominal tufts. Primaries pale ash-gray, with a more or less obvious fuscous shading, most evident along the costa and internal margin. T. a. line vaguely indicated on costa, the long outward tooth in submedian interspace fairly evident, a shorter, more acute tooth fairly distinct between vein 1 and the margin. T. p. line vaguely indicated on costa, becoming evident on vein 2, oblique inwardly to the claviform which indents it a little before the end of the tooth, then outwardly in an acute curve over vein 1. A narrow, broken, black terminal line, wanting altogether in the female. An oblique black streak below vein 2 from the t. p. line to outer margin. Claviform

fairly outlined in the specimens before me, somewhat paler, but not white as in *lætifica*. Ordinary spots vague, only the inferior margin of reniform at all distinct. Secondaries white basally with a rather indefinite dark outer border, much broader in the female. Beneath, primaries smoky in the ♂, blackish in the ♀. Secondaries white, with a few marginal powderings in the male, with broad outer borders and dark powderings in disk in the female.

Expands 48 to 52 millimetres=1.92 to 2.08 inches.

HABITAT: New York, Albany June 6, Sharon Springs August 15; Nebraska, West Point in May; Canada to Pennsylvania, west to Nebraska.

This species is easily separated from *lætifica* by the darker color of primaries as well as the course of the t. p. line, to which attention has been already called. There is also a series of fairly distinct interspaceal pale streaks extending in from the terminal space, which is not found in *lætifica*.

The harpes of the male are quite long, nearly parallel to tip; the latter is obliquely and acutely drawn out at upper angle, rounded at the inferior; its inner margin is spinulated as usual. The clasper is quite long, slender, acutely pointed, curved, and exceeds the margin of harpe.

This species seems not common and there are not many in collections. The specimens before me are from the collection of the U. S. National Museum.

Cucullia dorsalis sp. nov.

Head ash-gray, with darker and paler lines on front. Collar bluish-gray, with a black basal, and double brown median transverse lines. Patagiæ and dorsum gray, concolorous, dorsal tufts of abdomen inconspicuous, gray. Primaries a rather deep bluish-gray, without any fuscous admixture or shade; but with rather distinct black powdering. T. a. line much as in *speyeri*, but much more broken and less obvious. T. p. line evident only in submedian interspace, and there indistinct and broken, in course as in *speyeri*. The usual black streak below vein 2 is distinct, and above it, in the two following interspaces, are small sagittate black dashes, all that remains of the terminal line. Fringes gray, with a very narrow basal line. Claviform quite distinctly outlined by black scales, concolorous. Ordinary spots obsolete, save for a curved black line that may indicate the inferior margin of the reniform. Secondaries white at base, with a narrow and rather well-defined dusky outer border. Beneath primaries smoky, secondaries white, outer borders blackish.

Expands 46 to 50 millimetres=1.84 to 2 inches.

HABITAT: Colorado (Bruce).

Two females are before me, and compared with the same sex of *speyeri* they are purer blue-gray, lacking all trace of the fuscous shading. The markings are more powdery, black, and yet less complete.

The entirely concolorous dorsum of thorax gives the most obvious feature. The secondaries are like the ♂ of *speyeri* or the ♀ of *lætifica*, and, judging from these species, the male has a much narrower pale border to secondaries.

The sexual structures of the male will probably differ little from those of *speyeri*.

Cucullia bistriga sp. nov.

Ground color bluish ash-gray. Frontal vestiture with a considerable admixture of black scales. A black line at base of collar and a brownish line near its tip. Patagiæ with a submarginal dusky line. A brown, quite prominent, discolorous, metathoracic tuft. Primaries with all the veins narrowly black-marked, a dusky shade over the costa, and short, narrow interspaceal black lines in terminal space. T. a. line single, dusky, giving a long tooth into the median cell, a second into the submedian interspace, and a third to margin. T. p. line single, blackish, even, outcurved over cell and then parallel to outer margin. Reniform vague, dusky, moderate in size. A distinct black streak along the inner margin from base to t. p. line; another from the angulation of t. a. line in submedian space along the fold to s. t. space, then obliquely upward to outer margin between veins 2 and 3. A small subapical brown shade. Secondaries whitish basally, with an indefinite outer dark border; fringes whitish. Beneath grayish-white, powdery, primaries with a vague, dusky discal spot.

Expands 35 millimetres=1.40 inches.

HABITAT: Colorado (Bruce).

A very distinct species, differing from all the others at a glance. Two males, both taken by Mr. Bruce, one of them from Mr. Neumoegen's collection, are before me. The sexual characters are unique. The harpes are parallel, the superior angle of tip slightly produced. A chitinous ridge extends from the superior margin, near base, diagonally along and across the harpe, reaching the inferior angle of tip and there somewhat elevated and produced.

Cucullia intermedia Speyer.

1870. Speyer, Stett. Ent. Zeit. XXXI, 10–12, *Cucullia*.
1872. Lintn. Ent. Cont. I, 81, 85, pl. VIII, ff. 5, 7, *Cucullia*.
1874. Lintn. Ent. Cont. III, 170, *Cucullia*.
1878. Lintn. Ent. Cont. IV, 125, *Cucullia*.
umbratica‡ Gn.
1852. Gn., Sp. Gen. Noct. II, 147, *Cucullia*.
1870. Speyer, Stett. Ent. Zeit. 31, pr. syn.

Head fuscous, brown or dark gray, with blackish and white lines. Collar whitish inferiorly, dark gray superiorly, the difference less marked in the males. A black line through the white portion, and a double gray line separating the two shades. Thorax dull gray, with a fuscous admixture, dorsum very slightly darker, abdominal tufts loose,

dusky. Primaries dark bluish ash-gray with a fuscous admixture, all the markings obscure. In some specimens the median lines are traceable as follows: t. a. line as a broad, fuscous oblique shade over costa, outwardly toothed in the cell and there reduced to a fine black line, outwardly angulate again in the submedian interspace forming the usual long tooth, then again toothed below vein 1. The usual black basal line is evident in most specimens. The median shade is indicated by a broad, oblique fuscous streak across the reniform from costa. T. p. line single, fuscous, evenly outcurved over cell, then evenly oblique inward into the submedian interspace, where it forms an acute angle and is outcurved over vein 1. The ordinary spots are obsolete, in one specimen only the outer and inferior margin blackish-lined. Usually all the above-described maculation is incomplete and sometimes entirely wanting, save for the oblique dusky shades in costal region and the fragment of the t. p. line in the submedian interspace. A broken, black terminal line, sometimes sending in a small sagittate black dash in the second and third interspace, and often entirely wanting. Secondaries yellowish fuscous, somewhat paler at base, darker in the female. Beneath smoky on primaries, whitish powdery on secondaries; a more or less obvious discal lunule, sometimes a mere line, more usually a distinct ovate macula.

Expands 45 to 50 millimetres = 1.80 to 2 inches.

HABITAT: Canada; New York, Kendall, Sharon, August 8 to 16; Michigan; New Hampshire, Franconia; New Jersey; Illinois; Washington, D.C.; Northern, Eastern, Middle, and Central States.

This is the most common Eastern species of the second series, and seems as abundant as *asteroides*. It is very readily distinguishable from all others by the very dark gray primaries, in which usually all the markings save the oblique costal streaks are obscure, and by the yellow fuscous secondaries, which on the under side have a discal spot. There is little variation, only a relative distinctness or obscurity of maculation.

The harpes of male are long, narrow, slightly constricted centrally, the tip oblique, somewhat curved, inwardly fringed with spinules, upper angle acute. The clasper is a slender, upright corneous process with acute tip.

Dr. Lintner has described the larva on *Mulgedium leucophæum*.

Cucullia cinderella sp. nov.

Head fuscuos gray with pale and darker transverse lines. Collar deep ash gray, with an inferior black and a median double gray line. Patagiæ and dorsum dark gray, concolorous. Primaries deep bluish gray, immaculate save for a narrow linear basal streak and a broken black terminal line. Secondaries smoky, basally paler. Beneath, primaries smoky; secondaries white, powdery, and with a faint discal lunule.

Expands 41 millimetres =1.64 inches.

HABITAT: Colorado (Bruce).

This is a close ally of *intermedia*, than which it is smaller, all the maculation of primaries obsolete, the dorsum of thorax not dusky. The characters are obscure and would not be considered of specific value, were it not that none of the species thus far known inhabit both sides of the continent and that slight differences have proved permanent.

The sexual characters are very much as in the preceding; but the clasper is decidedly shorter and there is some difference in the form of the harpe, better seen in the figure than described.

I have only a single male for examination.

Cucullia serraticornis Lintn.

1874. Lintn., Ent. Cont., III, 174, *Cucullia.*
1875. Lintn., in Grote's Check List, pl. f. 10, *Cucullia.*
1883. Grt., Pr. Am. Phil. Soc., XXI, 161, *Cucullia.*
matricaria Behr.
1874. Behr., in Strck., Lep. Rhop. et Het., 94, *Cucullia.*
1875. Grt., Buff. Bull., II, 218 pr. syn.

"Antennæ biserrated; the serratures, which are less conspicuous at the base and tip, as seen from above, consist apparently of a row on each side beneath of conical projections, bearing rows of curved whitish cilia on their lateral margins beneath, which increase in length from the base to the apex. Palpi nearly horizontal, gray, with brown scales, third joint short and rounded. Front gray, with some black scales. Collar yellowish brown below the prominent black transverse line; above gray, with the usual paler line bordered with darker scales, and still darker ones on the upper margin of the collar. Tegulæ concolorous with the wings. Thorax fuscous; an abdominal series of similar colored tufts on the first four segments. Abdomen gray, paler basally. Primaries straight costally or slightly concave from the folding over of the marginal nervure, gently curving to the apex, which is obtuse; outer margin entire, sloping moderately to the inner margin, which is long and nearly straight. Color pale ash-gray, darker on the inner margin. Anterior median line blackish, teeth acute, preceded by a white shade, beyond which some blackish lines almost geminate it. Posterior median line obsolete, except in cell 1 b, where it is bidentate; the teeth preceded by an elongate oval, brown bordered, white spot on the submedian fold, extending to the anterior median line; followed by a white angulate line (the "tooth" of the internal angle), from the concavity of which a black streak (the usual interspaceal streak of the internal angle) runs obliquely to the first median nervule (vein 2). Costal margin over the place of the orbicular, with a diffuse brown shade and two oblique brown streaks at the inception of the posterior median. Basilar line black, fine; a slender black line on the internal margin. Reniform indicated by a row of black dots anterior

to the discal cross-vein; orbicular only visible as a central pale shade and four outer brown dots. Nerves and nervules clothed with black scales; on the interspaces intermediately are brown scales, with a whitish streak centrally, beneath which, on the subterminal margin, are the usual black streaks in all the interspaces, the most conspicuous of which is that in cell 4 (farther removed from the margin than the others). Fringes white, cut with brown on each side of the nervules, opposite the interspaceal lines of brown scales; these brown ciliary scales of each interspace joined by a brown marginal line. Secondaries acute, excavated opposite the cell, slightly dentate; white, hyaline. Nerves and nervules heavily marked with black scales, especially toward the margin; no distinct marginal border, but in place thereof the extreme margin is brown, with some brown scales extending a short distance therefrom, and farther in cells 1 b and 4; some brown scales on the costal nervure apically. Beneath, primaries pale brown, with an aeneous reflection; a conspicuous brown spot on the discal cross vein. Secondaries, with brown scales on the nerves and nervules and marginally as above, though less abundantly; sprinkled with brown scales costally and in the cell above the fold; cellular fold and discal cross vein above it broadly covered with brown scales, diffuse on the latter, giving a conspicuous cellular spot; these features seen in transparency from above.

"Described from two ♂ s, differing materially in size; the larger and better specimen, from which the features are mainly drawn, measures 2 inches expanse of wings, length of body 0.86 inch; the other, 1.70 inches expanse, length of body 0.72 inch.

"In addition to disparity in size, the two examples differ somewhat in shape of wings, those of the smaller being narrower and more acute, to the degree that the male usually varies from the female in the several species of this genus; yet the two examples are undoubtedly males, as is shown by their frenelum examination. In all other particulars, so far as they are traceable, the two are identical. They are, unfortunately, in poor condition, and the description above given may require correction."

HABITAT: California.

I have quoted Dr. Lintener's description of this species because I have only a single male, not in the best condition, before me. It is marked "Sauz., Mch. 23, 1878," and belongs to the U. S. National Museum.

The sexual characters are as distinctive and aberrant as is the antennal structure. The harpe narrows from a moderately broad base, very gradually, to an acute, corneous tip, which is a little curved and beak-like. The clasper is a stout, moderately long corneous process, with a spoon-shaped tip.

The insect seems rare, and it is rather strange that no females have been thus far received.

Cucullia solidaginis Behr.

1874. Behr., in Strck., Lep. Rhop. et Het., 94, *Cucullia.*

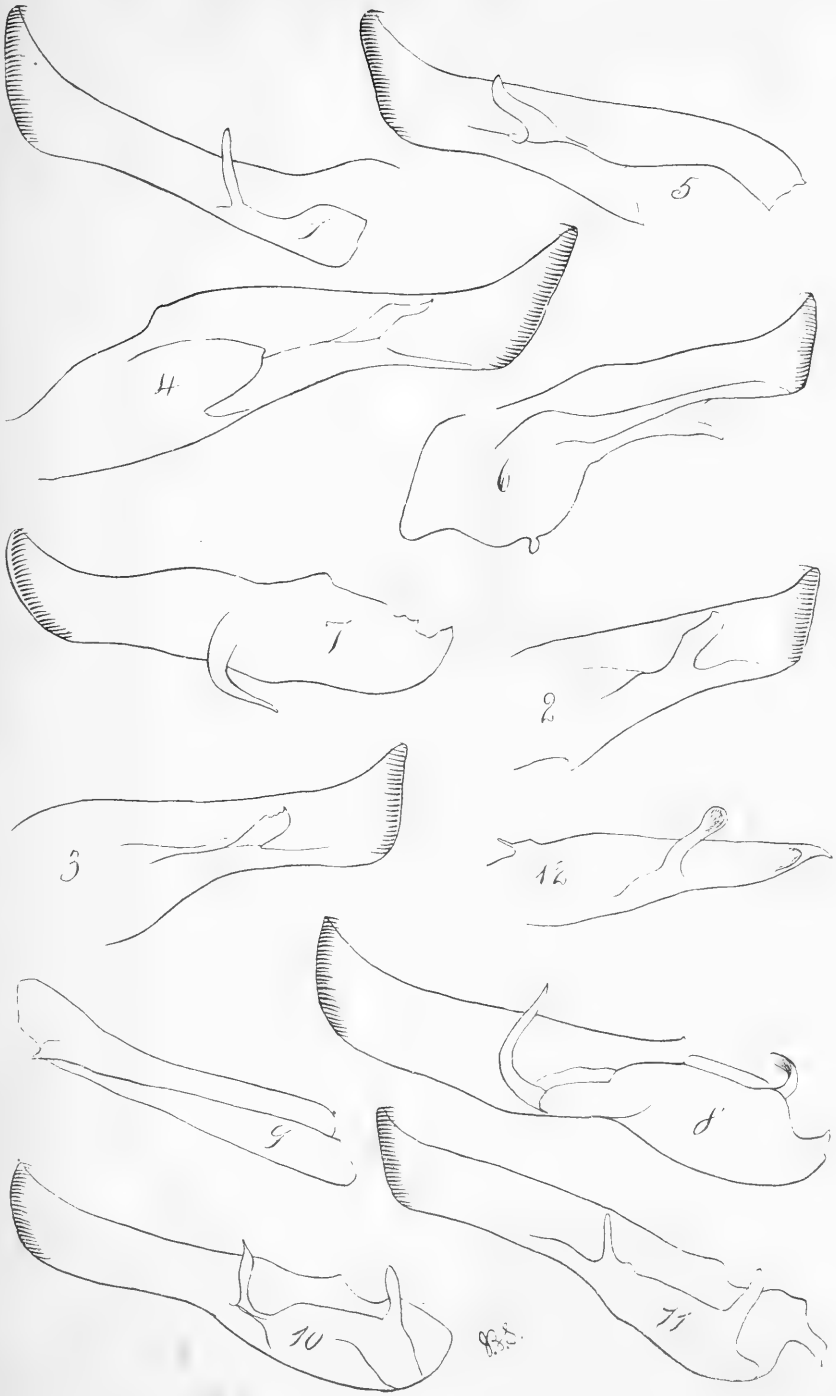
"Expands $1\frac{3}{4}$ to 2 inches. Head and tegulæ ashen, thorax between the latter dark gray with a brown dorsal line. Primaries gray, the median space suffused with darker color, which in one example tends to the base; it comes nearer in the markings to *lactucæ* Esp., but is entirely distinct from that or any other species known of. Secondaries smoky."

"California."

This description I can not apply. I have no material in the genus from California, and what little information is given excludes or includes any of our species, just as it happens to be interpreted. Such characterizations as the above are positive stumbling blocks to knowledge and are inexcusable. They exhibit an absolute ignorance of the intent of a description and a deplorable want of consideration for those who may be compelled to try to apply it.

EXPLANATION OF PLATE.

1. Harpe and clasper of Cucullia convexipennis.
2. Harpe and clasper of Cucullia montanæ.
3. Harpe and clasper of Cucullia similaris.
4. Harpe and clasper of Cucullia asteroides.
5. Harpe and clasper of Cucullia postera.
6. Harpe and clasper of Cucullia florea.
7. Harpe and clasper of Cucullia lætifica.
8. Harpe and clasper of Cucullia speyeri.
9. Harpe and clasper of Cucullia bistriga.
10. Harpe and clasper of Cucullia intermedia.
11. Harpe and clasper of Cucullia cinderella.
12. Harpe and clasper of Cucullia serraticornis.



GENITALIA OF CUCULLIA.

CONTRIBUTIONS TOWARD A MONOGRAPH OF THE NOCTUIDÆ OF BOREAL AMERICA. REVISION OF THE DICOPINÆ.

BY

JOHN B. SMITH, SC. D.

Under the title *Dicopinæ* Mr. Grote, in the Proc. Am. Phil. Soc., XXI, 154 (1883), separates a few species which seem to form a tolerably natural group, without being really entitled to subfamily rank. The species agree in having naked, more or less obviously lashed eyes, a robust, heavy thorax, but proportionately small, conic abdomen. The thoracic vestiture is dense, usually thick, sometimes coarse, never forming defined tufts, though there is usually a massing of the vestiture posteriorly. The head is somewhat retracted, sometimes quite obviously so, the tongue is weak and short, the palpi are small, not reaching or scarcely exceeding front, and the male antennæ are bipectinated. The tibiæ are not spinulose; but the anterior pair is armed with a stout, curved, corneous claw at tip. The anterior femora are quite stout, thicker than usual. Altogether the species have a bombyciform appearance, negatived principally by the short, narrow, pointed primaries of most of the forms. The venation is normally noctuidous except that in the secondaries the cell is unusually long and the furcation of the subcostal unusually near the outer margin. Three genera are recognizable, two of them rather illy defined, the third habitally more than structurally different.

Dicopis, the type of the group, has coarse, scaly vestiture, projecting straight forward on the front, giving it a scrubby, brush-like appearance. The head is slightly retracted and the abdomen has a series of more or less obvious dorsal tufts.

Eutolype is rather narrower winged than the preceding, the abdominal tufts weak or entirely wanting. The thoracic vestiture is finer and smoother, and the frontal vestiture is smooth, even, and more woolly in appearance. The head is somewhat more prominent, forming an even cone from the crown of the collar to the front. The shape of the head and the character of the vestiture are really the only distinctive features, and that they are not striking is shown by the fact that Mr. Grote kept the species together, separating only *rolandi* by the tuft of metallic scales at the base of thorax.

Copipanolis is a rather well-marked genus in which the wings are usually wider, more trigonate, the outer margin longer. The head is more strongly retracted and the thoracic vestiture fine, loose, and di-

vergent, giving the insect a plump, more bombycid habitus, emphasized by the more broadly pectinated male antennæ. The wings are rusty red brown or carneous gray, and powdery, so as to make them appear thinly scaled.

Although I know autoptically all save one of the species in this series (*viridescens* Wlk.), I have not given the sexual characters, partly because I have not had sufficient material of some species, and partly also because the characters in the forms examined are so simple as to be of little or no value in the separation of the species. In all there is a simple oblong harpe, near the center of which there is a small, corneous beak-like clasper.

None of the species are really common, and of those of which I have dates of capture all make their appearance very early in the season—a fact that may explain their rarity because they have disappeared when collecting usually begins. Mr. Grote makes the statement that they hibernate in the Chrysalis state.

DICOPIS Grt.

1874. Grt., 6th Rept. Peab. Ac. Sci., App. 23.
1882. Smith, Bull. Bkln. Ent. Soc., v, 20.
Copivaleria Grt.
1883. Grt. Pr. Am. Phil. Soc., xxi, 168.

In this genus the thorax is square, the patagiæ rather sharply defined, the primaries with the apices more marked. The character of the frontal vestiture has been already noted.

Three species, *grotei*, *muralis*, and *thaxterianus* are referable here.

Grotei is a dark, blackish gray species, with squammose or roughly clothed wings, the markings indefinite, the reniform usually white and contrasting, the s. t. space concolorous in all the specimens I have seen.

This species was first described as a *Valeria* by Mr. Morrison, a genus of which I have seen no American species as yet. I called attention to the erroneous reference in my synopsis of noctuid genera, and Mr. Grote suggested the term *Copivaleria* for the species, distinguishing it by the longer, more pointed, wings from *Dicopis*. The difference however does not exist, and I can find no safe points for distinguishing the genus.

Muralis is smaller, varying from a rather light ash to dark blackish gray, never as deep as in the preceding. The maculation is always traceable, and sometimes sharply defined. The reniform is large, better defined, and not so contrasting as in *grotei*. The s. t. space is usually more or less white, prominently interrupted in the submedian interspace by a black streak, which is often connected through the median space with the prominent basal dash.

Thaxterianus is the smallest of the species, in type of maculation like *muralis*, but quite evenly brown to the t. p. line, beyond which the ter-

minal space is whitish, powdery. There is not, in the specimens examined by me, any black dash opposite anal angle.

Electilis, if a *Dicopis* at all, belongs to this series and stands next to *muralis*, to which Mr. Morrison makes it "distantly" related.

Viridescens Wlk. is also probably a very near relative of *muralis*.

In synoptic form the species known to me autopically, are as folows:

A black dash in terminal space opposite anal angle.
Blackish, vestiture rough; lines incomplete, not well marked, reniform contrasting, white ..... GROTEI.
Gray, varying in tint; vestiture less rough; lines complete, usually well marked, reniform not contrasting ..... MURALIS.
No black dash in terminal space opposite anal angle, brown to the t. p. line, terminal space whitish ..... THAXTERIANUS.

Dicopis grotei Morr.

1874. Morr. Bull. Buff. Soc. Nat. Sci., I, 274, *Valeria*.
1882. Smith, Bull. Bkln. Ent. Soc., V, 44, an *Valeria?*
1883. Grt., Proc. Am. Phil. Soc., XXI, 146, 168, *Copivaleria*.

Head and thorax blackish or deep dark brown. A little tuft at base of antennæ whitish. Disk of thorax quite densely, of patagiæ sparsely white powdered, the latter with a black submarginal line. Primaries blackish or dark smoky gray, with mossy green shadings, unequally and somewhat inconstantly distributed over the surface. T. a. line geminate, black, outwardly oblique, irregular, variably distinct. A curved black basal dash looped beyond the t. a. line to form a broad claviform. Over this streak and in the claviform the wing is sometimes more or less white powdered. T. p. line geminate, black, irregular, fairly distinct, widely outcurved over the reniform, then deeply indrawn, touching the reniform inferiorly, reaching the inner margin opposite the space between the ordinary spots. A blackish median shade between the ordinary spots reaching the inner margin at about its middle. Beyond this shade extends a white blotch along the inner margin becoming bluish beyond the t. p. line, which is here emphasized and brought out prominently. S. t. line broken, irregular, mossy green or yellowish, with a deep inward sinus on vein 2, below which it is prominent and on which it is crossed by a black dash. Veins more or less evidently black marked. A broken terminal black line marked by blue powderings around the veins. Orbicular round, moderate in size, concolorous, with a whitish central dot and a whitish annulus which are sometimes indistinct. Reniform large, diffuse, usually white, contrasting. Secondaries white, black powdered on the veins and over the outer margin beyond a broken extra median line. Discal spot of underside visible above. Beneath soiled white with variably diffused black powderings, most obvious on the primaries. A more or less obvious outer line and distinct discal spot on all wings.

Expands 39 to 41 millimetres = 1.56 to 1.64 inches.

HABITAT: Eastern and Middle States to the Mississippi. Cambridge, Mass., April 26; Newtonville, Mass., May 12; Illinois.

Six specimens are in the Museum collection (Acc. 20395 and collection of O. Meske), from which the above description was made. The antennæ are yellowish. The color varies considerably in intensity, and fresh specimens have the mossy green tint most distinct. The transverse lines are not usually all traceable, while the large indefinite discolorous reniform is always evident and usually prominent, contrast-

ing. The white and blue patch on the inner margin beyond the median shade is also obvious in all specimens. The species seems not rare locally; but there are usually not many in collections.

Dicopis viridescens Wlk.

1865. Wlk., C. B. Mus. Suppl., 32, 601, *Cymatophora.*
1868. Grt. and Rob., Trans. Am. Ent. Soc., II, 86, *Hadena.*
1882. Grt., Ill. Essay, 40, *Dicopis.*

"*Male.*—Green, cinereous beneath. Proboscis slender. Palpi porrect, pilose, not extending beyond the head Antennæ tawny, moderately pectinated. Tegulæ of the thorax bordered with black and with whitish. Abdomen cinereous, extending rather beyond the hind wings. Fore wings black speckled; orbicular and reniform marks large, whitish, partly black bordered; an exterior whitish band interrupted near the internal angle by a broad green streak, which contains two little black lines; two black lines, one extending from the base, the other angular and proceding from the costa, both joining a whitish, black-bordered spot which is behind the orbicular; marginal points black. Hind wings dingy, cinereous; veins blackish towards the exterior border; under side with a black spot in the disk and an exterior blackish denticulate line. Length of the body 6 lines; of the wings 16 lines.

This species has some resemblance to *C. ridens*, but is most allied to *C. caniplaga*, and with it may form a new genus."

a. Florida. Presented by E. Doubleday, Esq.

It is not impossible that this is a form of *muralis.* The description fits it fairly well, but it would need Floridan material more closely agreeing with Walker's characterization to enable the reference to be definitely made. Mr. Grote's correction of the generic reference has alone made this suggestion possible, and he himself says it is "close to *D. muralis*, while smaller."

[Since the above was sent to the printer I have seen the type in the British Museum and find it to be *muralis* without a doubt.]

Dicopis muralis Grt.

1874. Grt., 6th Rept. Peab. Acad., App., 23, *Dicopis.*
1874. Grt., Bull. Buff. Soc. Nat. Sci., II, Pl. i, Fig. 1.

Ash gray varying to dark, smoky, or even blackish gray, in pale specimens with faint greenish washes. T. a. line geminate, black, with paler included spaces, quite usually subobsolete. A usually prominent black basal dash, looped beyond the t. a. line to form the claviform, which is broad and white powdered. Below this dash the basal space is white powdered. T. p. line geminate, quite acutely projected outwardly below costa, inwardly oblique, irregular, forming an acute angle on vein 2, and there almost reaching the claviform. Beyond this line the wing is usually white powdered, the s. t. line defined by the contrast between the dark terminal and paler subterminal spaces, cut in the submedian interspace by a prominent black dash. Sometimes the color is more even, and the s. t. line is then a broad, irregular, indefinite white line, cut as before opposite the anal angle. A row of black terminal dots, fringes also tipped by a broken brown line. Orbicular large, round, slightly paler, annulate, with whitish gray. Reniform large, pale, whitish, with a fuscous inner lunule, usually fairly well defined. A vague, irregular median shade between ordinary spots and following the angulations of the t. p. line. Secondaries somewhat fuscous gray, powdery, with discal lunules, variably complete extra dis-

cal line and distinct series of terminal lunules blackish. Beneath fuscous powdery over gray, primaries darker, secondaries with a broad outer line and distinct discal spot. Head and thorax concolorous with primaries, patagiæ with black submarginal line.

Expands 35 to 39 millimeters = 1.40 to 1.56 inches.

HABITAT: Middle States to the Mississippi and Texas. New York, (Brooklyn); Pennsylvania (Philadelphia); Illinois (Champaign); Central Missouri in April; Texas March 21.

Four specimens are in the national collection (collection of C. V. R., and Belfrage, and Acc. 20395) from which the foregoing description was made. The species is wider winged and as a whole smaller than the preceding, with the same general style of maculation. It varies in ground color and in distinctness of maculation, but most prominently perhaps in the s. t. line, which sometimes becomes a broad whitish shade. The large reniform is always distinctly paler, but not, in my experience, contrasting.

The species is not common.

Dicopis electilis Morr.

1875. Morr., Proc. Bost. Soc. N. H., XVIII, 114. *Dicopis.*

"Expanse 37 millimetres. Length of body, 14 millimetres.

Palpi short, scarcely exceeding the front. Antennæ of the male "pyramidal toothed, (this is a term used by Lederer). Anterior tibiæ with a long slender claw, otherwise unarmed. Thorax heavy and with coarse villosity; a distinct white band on each side of the tegulæ, which are black next to the wings. Abdomen short, dark and not untufted. Anterior wings cinereous gray, with the markings well defined; a very heavy black basal streak, including and extending beyond the claviform spot to the exterior line; ordinary spots concolorous, obsoletely encircled with black; interior line obsolete; exterior line distinct, black and narrow, with an indentation opposite the reniform spot, below which it is drawn in; subterminal line blackish, subobsolete. Posterior wings light gray; beneath gray, the posterior wings lighter, with discal dots.

Hab. Easton, Pennsylvania. From Mr. W. H. Stultz."

"Distantly allied to *Dicopis muralis* Grt.; it differs in the shape of the wings, which are narrow and *Cucullia*-like, the presence of the basal streak extending to the exterior line, and the absence of the distinct sub-anal streak of *muralis*."

There is a badly rubbed specimen, I believe in the Tepper collection, marked "type" by Mr. Morrison, in which the basal dash is broad and suffused; but I did not otherwise compare it with the description. The statement that the abdomen is "not untufted" excludes the species from *Eutolype* to which the species commonly known as *electilis* is best referred. The character found in the longitudinal dash extending from base to the t. p. line is a strong one, and should render the species recognizable. The term "pyramidal toothed" is used by Lederer for that form of antennæ in which the lateral processes are small, conic, and less than serrate. This does not agree with the character of the group, and Morrison either did not have a male, or the species may

not belong to this series at all. Mr. Grote has also seen the type and suggests that it seemed to him close to *muralis*.

Dicopis thaxterianus Grt.

1874. Grt. Buff. Bull. II, 196, *Dicopis*.
1881. Grt., Papilio I, 48, *Dicopis*.

"♂. The tibial claw is present, and the testaceous antennæ are bipectinated, somewhat less heavily so than in *D. muralis*. The colors are mainly those of *D. muralis*, but the wings are more uniformly fuscous to the subterminal line, and then the terminal space contrasts by its frosty, grayish white. Fringes distinctly checkered, fuscous and white; with the terminal line nearly obsolete, not resolved into black dots as in *D. muralis*. Ordinary spots ill defined, whitish, the reniform inwardly sharply margined with black, smaller than in *D. muralis;* orbicular rounded, black edged. Claviform quite small, concolorous, black edged, removed from the orbicular, hence very different from that of *D. muralis*. A fine basal black ray. No black streak above internal angle, and no black shading across the median space opposite the claviform. The median lines are distinctly marked with black, in general shape resembling those of *D. muralis*, but differing in slight details. The primaries are more pointed than in *D. muralis*, narrower and with the external margin more oblique, straighter and a little depressed before internal angle. Hind wings smaller, pale fuscous with traces of a double line on the veins, and with the faint terminal line not broken into points. Beneath much as in *D. muralis;* on the hind wings the discal mark is larger and tends to fuse with the median line, the latter exserted at this place, so that a fuscous O may be more or less completely outlined by the line and the discal lunate mark. Thorax hoary gray, the tegulæ black lined.

"Expanse, 35 millimetres. Taken April 8, 1874."

HABITAT: Massachusetts, Texas.

This species seems rare. I have seen but few specimens, and these showed little variation. It is smaller throughout than *muralis* and, as Mr. Grote says in the description quoted, the wings are narrower and lack the transverse line crossing the median space.

EUTOLYPE Grt.

1874. Grt., Pr. Ac. N. Sci., 1874, 198.
1882. Smith, Bull. Bkln. Ent. Soc., V, 21.
1883. Grt., Pr. Am. Phil. Soc., XXI, 154.

Four species seem referable to this genus—*bombyciformis*, *rolandi*, *depilis*, and *damalis*, all easily separated.

Bombyciformis is dark gray as a rule, with a black basal dash which meets the t. a. line from costa in an easy curve, and incloses a triangular space which in pale specimens is marked with rusty red brown. The s. t. line is usually distinct, most prominent and whitish opposite the anal angle, where it is marked with a blackish brown patch. The disk of the patagiæ is discolorous, pale gray.

Depilis is an ashy gray species in which all the markings are lost, save that the s. t. line is traceable and forms a whitish lunule in the submedian interspace. The ordinary spots are more or less completely defined by a narrow black line, and the space between them is very slightly darker.

In both of these species the costa is more convex than in any of the other species.

Damalis is a fine bluish gray species in which all the markings are written in narrow, slightly darker lines, and the s. t. line is not pale.

Rolandi is the smallest of the species of a dark, smoky, ash gray, the maculation barely traceable, but agreeing with *damalis* so far as it is visible. In fresh, perfect specimens the scales forming the loose, posterior thoracic tuft are chalybeus or metallic steel-blue, and from this character Mr. Grote derived his generic term, seeing in it a resemblance to the Bombycid genus *Tolype*.

In tabular form the species divide as follows:

S. t. line pale, distinct at least in s. m. interspace.
Dark gray, patagiæ discolorous gray; basal dash and t. a. line united, distinct.. BOMBYCIFORMIS.
Pale, bluish gray, all the lines obsolete, ordinary spots traceable..... DEPILIS.
S. t. line dusky, more or less broken.
Very bright bluish gray, all the markings well written, size larger..... DAMALIS.
Dark smoky gray; all the markings subobsolete, size smaller..... ROLANDI.

Eutolype bombyciformis sp. nov.

Head and thorax dark gray, varying to almost umber brown. Front reddish inferiorly. Disc of patagiæ paler, somewhat contrasting, blackish margined. Primaries varying from dark ash gray to blackish, the maculation almost obsolete in the dark forms. Basal line indicated in pale specimens. T. a. line dusky, obsolete, geminate, distinct to the basal black dash, which is here curved, hook-shaped, indicating the claviform and united to the t. a. line, together inclosing the upper part of basal space. In pale specimens the basal dash is marked with rusty red, recalling certain species of *Notodonta*. T. p. line faint, single, widely exserted over reniform, very irregular, and reaching the inner margin just within the s. t. line, where it is also best marked. S. t. line lunulate, black, followed by whitish or yellowish powderings, sometimes all obsolete, save a white lunule opposite anal angle, complete only in pale specimens. Orbicular round, very little paler, narrowly black ringed. Reniform large, upright, somewhat constricted centrally, with a broad vague pale annulus, inwardly emphasized with black. Secondaries whitish to smoky, darkest outwardly, with a faint outer line and discal lunule. Beneath varying from gray to smoky brown on primaries; paler, with an outer line and discal lunule on secondaries.

Expands 37 to 40 millimetres = 1.48 to 1.60 inches.

HABITAT: Ohio; Illinois; Missouri.

Four specimens are in the Museum collection (collection of C. V. R., J. B. S., and Acc. 20395), one of them marked No. 490, March 11, 1874, from the Riley collection.

This is the species which I had seen marked *electilis* Morr., in collections, and which I have so named on the faith of these determinations; but comparing the specimens at hand with the description, it is simply impossible that Morrison could have had similar examples before him.

Where the original erroneous determination came from I do not know, nor do I know where Morrison's type is to be found.

The small series before me shows quite a decided range of variation,

from the dark form in which the maculation is barely traceable to the bright bluish gray specimens in which every detail is evident, and the markings are additionally emphasized by rusty red brown scales. The Illinois specimen (Acc. 20395) came from the State Laboratory of Natural History at Champaign, and was named *Dicopis electilis* for them.

Eutolype depilis Grt.

1881, Grt., Papilio I, 48, *Dicopis*.

"♀ Smooth, dark gray in color, recalling *Eutolype Rolandi*, but without the metallic tuft of scales on the thorax behind which separates *Eutolype* from *Dicopis*. Interior line fine, black, projected opposite the claviform spot. Claviform with a tinge of yellowish, moderate, somewhat rounded and incompletely ringed with black. Orbicular, spherical, concolorous gray, with a paler ring edging the faint annulus within. Reniform similar, very large, medially constricted. Outer line fine, irregular, waved, much removed outwardly. There is a flecking of yellowish outside of the fine subterminal line, which runs very close to the outer median line, at inner angle. Hind wings whitish, with gray shaded edging and fringes; beneath, with dot and line. Head and thorax dark gray. Size of *Muralis*, or perhaps a little larger and seemingly stouter. Columbus, Ohio.

"* * * Finally, I have a female specimen from Texas, collected by Belfrage, which comes near to *Depilis*, but may prove a distinct species; it is numbered 697."

The above is Mr. Grote's original characterization. Two female specimens are before me, agreeing with the description save for a somewhat paler ground color, very indistinct markings and slightly darker shade between the ordinary spots. Both are from Texas, collected by Belfrage, dated March 21; one of them was given me by Mr. Grote himself, is labeled *Dicopis depilis* in his own handwriting, and is probably the specimen referred to in his description. The other is from the Belfrage material in the Riley collection, and is numbered 697 on a red label. The label would indicate that Mr. Grote concluded that the Texan specimens were not distinct from the Ohio type, and I have no doubt he is correct. I have also seen the species from New York State.

Eutolype rolandi Grt.

1374. Grt., Proc. Acad. Nat. Sci., XXVI, 198, *Eutolype*.
vernalis Morr.
1874. Morr. Proc. Bost. Soc. N. H., XVII, 133, *Copipanolis*.
1875. Grt., Can. Ent., VII, 17, pr. syn.
1875. Grt., Bull. Buff. Soc. N. Sci., II, 210, pr. syn.

Dark ash gray, sometimes almost blackish. Head and thorax usually a little darker, patagiæ indistinctly blackish margined, disc with a posterior tufting of metallic bronze brown scales, which lose their luster in old specimens. Primaries with the maculation vague, indefinite, the median lines barely traceable, sometimes entirely obsolete. T. a. line geminate, rather evenly oblique outwardly. T. p. line apparently single, its course much as in *muralis* as far as traceable. A faint nearly upright median shade is perceivable in some specimens. S. t. line always marked as a series of blackish dots, sometimes becoming nearly connected, and often relieved by a sparse powdering of greenish white scales. The claviform is not traceable in any of my specimens. Orbicular moderate, round, concolorous, imperfectly black ringed, usually marked by an annulus of pale yellowish scales, rarely almost obsolete. Re-

niform large, upright, slightly constricted in the middle, concolorous, incompletely marked with darker scales and often by paler yellowish white atoms. Secondaries whitish, densely dark powdered, with a distinct blackish marginal line and a faint discal lunule. Beneath gray, powdery, primaries with disc darker, secondaries paler, with an outer line and discal lunule.

Expands 31 to 35 millimetres = 1.24 to 1.40 inches.

HABITAT: Massachusetts, April 8 to 15; Missouri, April and May; Texas, February 17 to 26.

Nine specimens, all males, and all save one from Texas (Belfrage in collection of C. V. R.), are before me. I have seen a number of other specimens and there is very little variation save in the distinctness of the maculation. As a rule the punctiform s. t. line is quite distinct and usually also the ordinary spots are evident. In fresh specimens the metallic shining scales at base of thorax constitute an unfailing index to the species; but in old specimens or when they show even a slight tendency to grease, the metallic luster disappears, and the genus as based on this character becomes irrecognizable.

Eutolype damalis Grt.

1880. Grt., Bull. U. S. Geol. Surv., v, 208, *Dicopis*.
1881. Grt., Papilio, I, 49, *Dicopis*.

"♂. Fore tibiæ each with a long black claw; eyes naked; antennæ testaceous, bipectinate. Clear, bluish gray. Ornamentation of primaries feebly written. Orbicular round, reniform narrow, curved, upright; the lines are double, and with the spots indicated by pale brown shade lines, all concolorous with the wings. Thorax shaggy, bluish gray. Hind wings whitish, a little soiled, with discal dot, faint terminal lines, and whitish fringe. Beneath white, with black discal spot and broken black mesial line. Fore wings gray, with faint broad exterior shade line. Feet and abdomen gray. Expanse 34 millimetres."

HABITAT: Havilah, Cal.; Alameda, Cal.

This is a well-defined species most nearly related to *rolandi*, but larger, somewhat wider winged, a fine pale bluish gray in color, and lacking all trace of the metallic scales.

COPIPANOLIS Grt.

1874. Grt., 6th Rept. Peab. Acad. Sci., App., 25.
1882. Smith, Bkln. Bull., v, 21.
1883. Grt., Proc. Am. Phil. Soc., XXI, 154.

This genus is distinguished from the others of the group by the thin long hairy vestiture of thorax, forming no obvious tufts, by the brownish red or gray colors, the wings powdered with darker brown atoms and appearing more thinly scaled, and by the generally more bombycid habitus of the species.

Only one species was known for sixteen years, but I have now recognized four very distinct forms, separable as follows:

Borealis, a new species, differs from all the others in color, the head, thorax and median space of primaries umber brown, the basal and

extra medial space of primaries pearl gray. The median lines are well defined, the ordinary spots obvious and secondaries black.

All the other species are reddish brown in color, the secondaries paler than the primaries.

Cubilis, the type of the genus, has the median lines distinct, diffuse, the ordinary spots more or less obviously discolorous, the terminal space paler than the rest of the wing, s. t. space brownish.

Fasciata is the common Texan species that usually does duty as *cubilis* in collections, but can not well be that species. The color is always uniform, the lines are broad and distinct, and the ordinary spots are vague, never discolorous in my experience, and I have seen many specimens.

Stigma is a Floridian form differing from all the preceding in lacking almost entirely the median lines, the ordinary spots whitish, blotchy and contrasting. In color it is a different shade of red, more admixed with yellow, and distinguishable at a glance.

These characters will serve to distinguish the forms, further details being given in the specific characterization.

Copipanolis borealis sp. nov.

Head, thorax, and median space of primaries umber brown, the latter powdery; basal and extra medial space pearl gray, powdery. T. a. line darker brown, not sharply defined; t. p. line broad, brown, distinct, evenly bisinuate. Ordinary spots moderate in size, vague, rather indefinitely outlined and with sparse pearl gray powderings. Secondaries blackish, apices gray powdered. Beneath gray, powdery, primaries smoky on disc, secondaries with a broad outer line.

Expands 28 millimetres = 1.12 inches.

HABITAT: Minnesota (St. Anthony Park), April 7, 1889.

Of this remarkable species, a single male specimen from Mr. Schoenborn's collection, taken by Mr. O. Lugger, is before me. In wing form, vestiture and pattern of ornamentation the resemblance to the described species is striking, while the entirely different coloration gives the insect a strangely unfamiliar appearance.

Copipanolis fasciata sp. nov.

General color of the entire insect a rusty red brown, secondaries slightly paler. The wings are powdered with somewhat deeper brown atoms, less dense beyond the t. p. line. Median lines single, broad, somewhat diffuse, deeper brown. T. a. line even, with a slight outcurve centrally. T. p. line rather evenly bisinuate, the curve a little broken opposite the cell. S. t. line wanting. A vague terminal line, sometimes entirely wanting. Ordinary spots vague, orbicular rarely traceable, never distinct, reniform vaguely marked, sometimes wanting entirely, usually noticeable as an indefinite dusky shade, never prominent. Beneath, the brown has a grayish tendency, the powdering more noticeable than above.

Expands 32 to 35 millimetres = 1.28 to 1.35 inches.

HABITAT: Missouri (C. V. R.), April; Texas, Belfrage, January and February. Ten specimens are in the U. S. National Museum.

This species is easily recognizable by its almost uniform coloration, the median lines forming the only obvious markings. It is the species usually marked *cubilis* in collections, but differs from that species by the broader, less pointed primaries and by lacking the differences in shade, and all trace of the s. t. line.

The species is perhaps the most common of all the forms belonging to the present series, the Belfrage material containing quite a number of them.

Copipanolis cubilis Grt.

1874. Grt., 6th Rept. Peab. Ac. Sci. App. 26, *Copipanolis.*
1874. Grt., Buff. Bull. II, Pl. 1, p. 6, *Copipanolis.*

The male has a stout bombyciform appearance, though of moderate size, resembling in this respect as well as in the ornamentation of the primaries, the European *Panolis piniperda.* Rich ochrey honey-brown; ornamentation simple. The two median lines are distinct, continued, rather diffuse, darker than the wing, the t. a. line perpendicular, waved superiorly, the t. p. line followed by a pale shade, very oblique, much produced superiorly on the costal nervules, bending inwardly to vein 2, and narrowing the median space below this to internal margin, running inferiorly nearly parallel with the t. a. line. Ordinary spots, more or less distinct, dirty whitish, or again hardly paler than the wing and yellowish, separate, ringed with reddish, the orbicular spherical, the reniform with a central stain, of the usual shape, well outwardly removed in position, subterminal space more brownish than the paler terminal space. Hind wings pale fuscous, with a reddish tint. Beneath pale, with an even reddish band and discal spot on hind wings. Thorax and head concolorous with primaries above; abdomen dark. Expanse 36 millimetres.

HABITAT: Lansing, Mich., March 26th; Massachusetts.

The above description is Mr. Grote's original characterization, and the figure given by him in Buff. Bull. II, agrees with it very well.

I have seen the type in the British Museum and find that it agrees well with the figure and description; also that the Texan form is specifically distinct.

Copipanolis stigma Smith.

1890. Smith, Ent. Amer., VI, 220, *Copipanolis.*

Head, thorax, and primaries deep brick red; palpi paler. Primaries with a slight admixture of yellowish scales, most evident along costal region. Median lines vaguely marked, scarcely defined; ordinary spots yellowish white; orbicular small, round; reniform moderate in size, rather irregular. Secondaries whitish at base, with reddish powderings, becoming more dense outwardly. Beneath somewhat paler than above, more obviously yellow powdered.

Expands 29 millimetres = 1.15 inches.

HABITAT: Florida.

This species, of which I have seen a single male only, differs from the others in the almost total obsolescence of the median lines and the distinctness of the ordinary spots. The latter may, however, be unimportant and variable. There is a more decided yellow admixture in the ground color than is found in the common species.

LIST OF THE SPECIES.

DICOPIS Grt.
Copivaleria Grt.
grotei Morr.
viridescens Wlk.
muralis Grt.
electilis Morr.
thaxterianus Grt.
EUTOLYPE Grt.
bombyciformis Smith.
depilis Grt.
rolandi Grt.
vernalis Morr.
damalis Grt.
COPIPANOLIS Grt.
borealis Smith.
fasciata Smith.
cubilis Grt.
stigma Smith.

CONTRIBUTIONS TOWARD A MONOGRAPH OF THE NOCTUIDÆ OF BOREAL AMERICA.—REVISION OF XYLOMIGES AND MORRISONIA.

BY

JOHN B. SMITH, SC. D.

(With Plate III.)

XYLOMIGES Gn.

1852, Gn., Sp. Gen., Noct., I, 147.

Eyes hairy, round, moderate. Head small, retracted, with even, short, stiff, scaly vestiture, forming superposed flattened frontal tufts. Palpi short, reaching to, but scarcely exceeding, the front. Tongue long and strong. Antennæ in the male pectinated, serrate and bristled, or ciliate merely. In the female they are simple, only sparsely ciliated. Thorax robust, quadrate, convex, with a variably distinct anterior and posterior tuft. Abdomen dorsally tufted. Legs unarmed, save for the ordinary spurs of middle and hind tibiæ. Primaries narrow, trigonate, elongate, with marked apices and obliquely rounded outer margin, or short, narrow, and stumpy.

From *Mamestra* this genus differs by the shorter palpi, the more retracted head, the superposed frontal tufts, the wing form, and in some instances by the pectinated antennæ.

From *Morrisonia* it differs in not having the divided thoracic crest, the thorax itself stouter, the abdomen not so long proportionately, and the primaries not retracted at anal angle nor strigate in type of maculation.

From *Stretchia* (*Perigrapha*) the species differ in the thoracic tuftings and somewhat also in wing form. Strictly, only two of our species—*curialis* and *dolosa*—are congeneric with the European *conspicillaris;* but there is no safe line for the separation of any of the species, save possibly *patalis*, which differs by the habitus, the short stumpy wing, somewhat depressed body, and simple male antennæ. Antennal characters are weak in the hairy eyed genera, and so indeed are most others. It is difficult to limit the genera in this series, and comparative characters and habitus must serve largely as guides. The lines of demarcation between this genus and *Mamestra*, *Morrisonia*, or even *Tæniocampa* are nowhere sharply defined and errors are easy, especially with imperfect or insufficient material.

I place at the head of the series the species in which the male antennæ are pectinated, the primaries moderately wide, trigonate, the apices well marked.

Hiemalis is a small species in which the median lines are usually not well marked. The ordinary spots are distinct, the reniform is marked with reddish, and there is a distinct curved basal dash, above which there is a somewhat prominent paler shade. The antennal pectinations are very long, and there is a series of black spots before the s. t. line.

Peritalis is larger, with much the same type of maculation. There are no shades or spots before the s. t. line, and the antennal pectinations are much shorter.

Crucialis is a much paler form than any of the preceding, somewhat smaller than *peritalis*, from which it differs in having the darker terminal space completely cut on veins 3 and 4, leaving two triangular blackish patches.

To the second series, in which the male antennæ are serrate and ciliate, belong *curialis*, *dolosa*, *perlubens*, *subapicalis*, *rubrica* and *ochracea*.

Curialis and *dolosa* are narrow-winged forms, like the European species, the colors dark ash gray. In *curialis* the color is even, with a faint reddish suffusion and no white lines or patches.

In *dolosa* the color is powdery, blackish, the orbicular white; below it a white band extends to the inner margin, giving the wing a characteristic appearance. The s. t. line is also white, or paler at least.

Perlubens I do not know. Mr. Grote says it is related to *rubrica*, and so it seems to be. It is not possible to specify exactly wherein it differs, from the description, except that the orbicular is said to be upright. In *rubrica* it is oblique, elongate, in all the specimens seen by me.

Rubrica and *subapicalis* are broader winged than *curialis* and *dolosa*, and the outer margins are obviously dentate, which is not the case with the latter.

Rubrica is a powdery, reddish gray form, sometimes almost even in color, sometimes quite strongly maculate, the ornamentation taking form as a distinct preceding shade to s. t. line, sending in a black shade opposite the cell, so as to relieve and lighten the apical region. The orbicular is elongate, oblique, oblong, and gray in color. The insect looks like a *Tæniocampa* at first sight, and the generic characters are not strong.

Subapicalis I once thought a form of *rubrica*, and so described it. It differs, however, not only in the sexual characters, but in the uniformly ash or blackish gray ground color, and in the form of the orbicular, which is upright and broadly oval. In other details of maculation it is like *rubrica*. This species looks as much like a *Mamestra* as *rubrica* does like *Tæniocampa*, and well illustrates the artificial character of the hairy eyed genera.

Ochracea is unlike any other of the species. It resembles *patalis* in wing form; but is of a dull, luteous, ground color, with the veins

white marked. The median lines are also white marked. The ordinary spots large, discolorous, white, or at least white ringed. Altogether it is unique in color and habitus, and therefore easily recognized. The head is more retracted, and has the frontal tufts less evident than in the other species.

Patalis is the only species in which the antennæ of the male are entirely simple, and it is also the smallest of the genus. It is a stout, rather stumpy winged form, contrasting quite strongly with some of the other species, and yet with a certain habital resemblance to them. In color it is pale whitish or bluish gray, sometimes with a creamy tint, and more rarely with a yellowish suffusion. The median lines are somewhat indistinct, closely approaching at the hind margin, and giving the median space, which is usually darker, a somewhat irregular V-shape. Rarely a specimen will lack all maculation save a few black spots marking the s. t. line. The ordinary spots are large, pale, and quite generally fused inferiorly.

Tabulata is known to me in the female only. It is a dark, blackish-gray species, with close, smooth scales. The maculation is evident, the s. t. line marked at anal angle with a black spot in a reddish suffusion. It resembles a *Mamestra* of the *manguina* type quite strongly.

The genitalia of the species are separately described hereafter. There is no distinctive type, though the majority of the species resemble each other to some extent.

The early stages of some of the forms are known to Dr. Riley; but, so far as I am aware, have not been described.

In tabular form the species separate as follows:

1. Antennæ of male distinctly pectinated 2
   Antennæ of male serrated and bristled 3
   Antennæ of male simple, finely ciliated 4
2. Primaries trigonate, narrower at base; s. t. line complete:
   Smaller; antennal pectinations long ..... HIEMALIS.
   Larger; antennal pectinations short ..... PERITALIS.
   Primaries elongate, parallel, scarcely narrower at base; s. t. line obsolete; pale ash gray, two distinct black trigonate shades toward outer margin ..... CRUCIALIS.
3. Narrower winged, fringes not or scarcely dentate; color not luteous:
   Even ash gray, with a faint reddish tinge; s. t. line marked only by a series of blackish spots ..... CURIALIS.
   Dark blackish gray; a whitish patch below orbicular to hind margin; s. t. line white, preceded by black spots ..... DOLOSA.
   Broader winged; primaries trigonate, elongate; fringes distinctly dentate:
   Variegated with reddish and gray, veins blackish, orbicular upright ..... PERLUBENS.
   More even, reddish gray; a more or less evident black shade from reniform to outer margin below apex; orbicular oblique, elongate ..... RUBRICA.
   Dark ash gray; a reddish shade from reniform to apex; orbicular ovate, upright ..... SUBAPICALIS.
   Broad and stumpy winged; fringes not dentate.
   Dull luteous; veins and median lines white; ordinary spots large, usually pale; s. t. line yellow ..... OCHRACEA.
4. Primaries short and stumpy, fringes not dentate:
   Pale whitish or creamy gray; median space darker, V-shaped, ordinary spots large, often fused ..... PATALIS.

Xylomiges hiemalis Grt.

1874. Grt., Buff. Bull., II, 71, *Xylomiges.*
californica Behr.
1874. Behr. in Strk. Lep. Rhop. et Het., 94, *Dryobota.*
1876. Grt., Can. Ent., VIII, 26, pr. syn.
1878. Grt., Bull. U. S. Geol. Surv. IV, 178, *Xylomiges.*
1879. Grt., Can. Ent. XI, 29, pr. syn.

General color ash gray, with a slight reddish tinge. Head fuscous on front, paler on vertex; collar with a black line near tip; thorax with a small black central tuft, and a lateral line on patagiæ at the base of the wings. Primaries, basal line marked only by a geminate costal spot; a curved black mark from base below median vein to the subcostal vein near the t. a. line; above this the color is pale, beneath much darker and tinged with fuscous. T. a. line very variably distinct, geminate, often only the somewhat paler included space obvious, inner line never distinct; in general course it is somewhat oblique outwardly, a little curved between veins. T. p. line more or less indefinite, always traceable, dusky, better marked in costal region, where it is geminate. It is rather distant from base, well outcurved over the reniform, but not much incurved below. Between the ordinary spots a median shade darkens the intervening space, thence continues as a narrow and rather faint line, nearly upright in course, to the hind margin. S. t. line pale, marked on either side by a blackish shade which is broader in the terminal space, making a feeble W on veins 3 and 4, in some specimens much less marked and almost even. Claviform small, black ringed, concolorous or somewhat darker; beyond it the submedian interspace is paler to the s. t. shade. Orbicular large, pale, oval, superiorly open to the costa. Reniform moderate, upright, with a median brownish-red shade, inferiorily darkened also by the median shade. Beyond the middle a pale shade extends to the s. t. line. The s. t. shade consists rather of a series of closely connected interspaceal lunules, of which the central are in rare cases obsolete. Secondaries whitish, with a distinct discal dot, a more or less obvious exterior line and with fringes cut with black. Beneath, primaries smoky, secondaries white; both with an exterior line and discal dot.

Expands 27 to 31 millimetres=1.10 to 1.25 inches.

HABITAT: California.

Several specimens are in the collection of the U. S. National Museum, all from California (O. Meske; Alameda County, January, through C. V. Riley).

The species is easily recognizable by the small size, combined with the very long pectinations of the antennæ and large, distinct, ordinary spots.

The genitalia have the harpes bent toward tip, and tapering to an obtuse point; the clasper is chitinous, stout, rather long, curved somewhat more than the angulation of the harpes. The species seems not uncommon, and is one of the most generally represented in collections.

Xylomiges peritalis sp. nov.

Ground color of head, thorax, and primaries bluish gray, powdery, the maculation blackish. Palpi with a faint, pink tinge. Front with a blackish band across base and another at middle. Collar with a black transverse band. Patagiæ black margined at base of wings. Primaries with the transverse lines marked by geminate spots on costa, but very vaguely marked below. A black longitudinal line at base to t. a. line, and opposite is the large, concolorous claviform outlined in black. A black bar from the t. a. line to the large, pale orbicular, which is oval, black margined, but not defined superiorly, narrowly confluent with the large kidney-shaped reniform. A dusky oblique shade from costa between the ordinary spots crosses the reniform inferiorly and darkens it; outwardly the spot is incomplete, and from it a faint ocherous stain extends to the terminal space. The veins are all more or less evidently black marked, and beneath vein 1 is a dusky shade. T. p. line evenly bisinuate, concolorous, barely traceable by the faint fuscous defining lines. S. t. line evident, marked with a few yellow scales, but defined principally by the blackish terminal space, somewhat toothed on veins 3 and 4. Fringes dentate, cut with blackish, gray at base. Secondaries white, faintly reproducing the maculation of under side. Beneath white, primaries black powdered, most evidently near outer margin, a faint discal spot, an incomplete extra discal line, and a row of terminal dots; secondaries powdered only along costal margin, with a large black discal spot, a punctiform extra discal line, and a subcontinuous marginal line.

Expands 40 millimetres=1.60 inches.

HABITAT: Colorado (Bruce); Oregon (Strecker).

A single specimen in good condition from Mr. Neumoegen's collection; but I have seen others, also of Mr. Bruce's collecting. In wing form, general habitus, and type of maculation this species is the close ally of the Californian *hiemalis*. It is, however, decidedly larger, and the pectinations of the antennæ of the male are very short, in marked contrast to the long branches on *hiemalis*.

The occurrence of such forms, closely allied in all habital and ornamental details, with so evident a structural character, is interesting.

The sexual characters again are very much like those of *hiemalis*, in the form of the harpes at least; the clasper is distinctly different, as may be seen by a comparison of the figures of each.

Xylomiges crucialis Harvey.

1875. Harv. Buff. Bull. II, 277, *Xylomiges*.

Ground color pale bluish gray. Head with vertex slightly darker. Collar with a black transverse line. Thorax with a black crest line, patagiæ with a lateral line at base of wings. The primaries have all the veins black marked, the ordinary lines obsolete. A distinct black

basal dash extending into the long claviform, which is concolorous, black ringed and reaches to the middle of the wing. From the upper edge of this basal streak, another curved black line runs to the subcostal, and then curves downward to form the margin of the elongate, large orbicular, which is open to the costa. The costal region from the base to this point is usually paler, more whitish than the rest of the wing. A distinct median line starts at costa, outwardly oblique, forming the outer margin of the orbicular and separating it from the reniform, inwardly angulated on the median vein and thence, much less defined, to the middle of the hind margin. Orbicular elongate, oval, oblique, open to costa. Reniform upright, dilated inferiorly, incompletely black, then white ringed, inferiorly dusky, centrally with a more or less intense clay-yellow shade, from which a tinge extends outwardly, nearly to the apex. The t. p. line is sometimes marked by a geminate black spot on costa above reniform, and beyond this the costal region is dusky to the apex. From the inferior margin of the reniform an oblique dusky shade extends to below the apex, marked in its course by black streaks extending through the interspaces, and reaching the outer margin at a black spot in the fringe. A second triangular dusky patch is above the anal angle marked by two interspaceal dashes. Secondaries white, subtransparent, with black discal dot and broken median and terminal line. Beneath white, powdery, primaries with veins black marked, both wings with variably obvious discal spots and broken exterior and terminal lines.

Expands 35 to 38 millimeters=1.40 to 1.52 inches.

HABITAT: Vancouver; California; Colorado; Oregon.

Of this species Mr. Dyar sent me a large number of specimens, all more or less broken, taken at the electric lights at Manitou in May. The species has not been common in collections heretofore. I have also received it from Mr. Bruce, taken near Denver. In the fifty or more specimens before me I note no variations, and the species is an easily recognizable one. The primaries are more parallel than in the other species with pectinated antennæ and the pattern of maculation is obviously different. The curved, black basal markings, above which the wing is paler, the elongate oblique orbicular open to the costa, and the two triangular dark patches in the s. t. space, are characteristic.

The harpes of the male narrow somewhat irregularly to a roundedly acute tip. A long, curved, corneous clasper arises a little basad the middle of the harpe and does not attain its tip. At the base of this large hook is a smaller, less curved and less acute process, which barely exceeds the lateral margin of harpe.

The original description of this species is incomplete and differs in detail so much from the above that had I not seen the types in Mr. Edwards's collection, I might have hesitated to make the identification.

Xylomiges curialis Grote.

1873. Grt., Buff. Bull., I, 143, *Xylomiges*.

Bluish ash gray, head and thorax concolorous, immaculate. Primaries with a faint reddish tinge. Veins black marked, irregularly interrupted by white scales. All the lines vague, indistinct. Basal line broad, diffuse, hardly darker than ground color, fairly distinct on costa only. T. a. line upright, geminate on costa only, irregularly dentate on the veins, a longer outward tooth in the submedian interspace, representing the claviform. An indistinct brown shade line accompanies the darker defining line and becomes somewhat diffuse in the submedian interspace. T. p. line vague, indistinct, marked by more prominent venular points, and defined mostly by a dusky median shade which starts from the costa between the ordinary spots, darkens the outer half of the median space and obscures the reniform. The s. t. line consists of an oblique series of rusty, dark brown interspaceal dots, of which the lower and larger are emphasized by a few black scales. A series of black interspaceal terminal dots. Fringes dusky. Orbicular almost round, slightly irregular, not defined, somewhat paler than ground color. Reniform rather large, upright, constricted medially, centrally darkened by the median shade, rather incompletely defined by a dull, rusty brown annulus or ring. Secondaries white, subhyaline, with a small discal spot and a broken terminal line, black. Beneath wings white, primaries with a somewhat smoky disc, a small black discal spot and a line of terminal dots on both wings black; secondaries with an extramedian, punctiform transverse line.

Expands 38 to 40 millimetres=1.52 to 1.60 inches.

HABITAT: California, Alameda County, in March.

This species is readily recognized by the more than usually robust body, the narrow primaries, of which the hind angle is somewhat retreating, and the more xyliniform habitus. The thoracic tufts are small, the thorax itself plump and convex, the abdomen short and conic.

The sexual characters are distinctive and unlike any other of the species. The harpes are broad, subequal to the tip where the lower angle is obtusely rounded, the upper produced into a long, trigonate point. A long curved corneous clasper closely follows the margin of the harpe, and is supplemented by a short, stout, obtuse process at base.

Xylomiges dolosa Grote.

1880. Grt., Can. Ent. XII, 88, *Xylomiges*.

Ground color dull blackish, powdery, over a white ground, sometimes with a faint olivaceous tint. Collar quite obviously gray shaded; thorax less distinctly so. Abdomen blackish, powdered. The primaries are quite evenly colored, a paler shade visible in basal space and beyond t. p. line, while a more obvious and often prominent whitish shade extends below the orbicular to the hind margin. The ordinary lines

are geminate, black, not well marked. Basal line geminate, fairly distinct, a black, feebly marked basal dash. T. a. line upright, slightly lunulate. T. p. line evenly bisinuate, followed by a series of white, then of black, venular dots. A more or less evident median shade line. S. t. line whitish, nearly even, preceded by a series of lunate black marks. Veins black marked through terminal space. A fine black terminal line. Fringes finely cut with white. Claviform whitish, discolorous, triangular, acute. Orbicular white marked, round or ovate, upright. Reniform large, upright, more grayish, usually darker than orbicular. Secondaries dirty white, outwardly black powdered, forming a variably distinct submarginal band and blackish terminal line. Discal spot of under side faintly visible. Beneath white, powdery, both wings with a more or less obvious dark outer line and discal spot.

Expands 37 millimetres=1.48 to 1.50 inches.

HABITAT: Orono, Me.; Plattsburg, N. Y.; Franconia, N. H.; Colorado (Bruce).

This is a distinctly marked and easily recognizable form, differing by its dull, lusterless black appearance from all the other species. It was originally described by Mr. Grote from Prof. Fernald's collection, and with this I identified specimens sent me by Mr. Bruce from Colorado. In the U. S. National Museum is a specimen sent by Mr. Hudson, from Plattsburg, N. Y., and Mrs. Slosson has sent me the species from Franconia, N. H., for determination. The distribution is therefore wide; but confined to high latitudes and mountainous regions. There is no apparent difference between the Colorado and New Hampshire specimens now before me. The sexual characters are somewhat like those of *curialis* in type. The harpes are narrowed beyond the middle, somewhat dilated again at tip which is inwardly fringed with spinules, and the superior angle of which is furnished with a thick, blunt, corneous spur. There are three corneous clasper processes. The first, at lower margin near base, short, broad, beak-like. The second at middle of upper margin, with a broad corneous base and a moderately slender, nearly straight process. The third arises from the middle of the harpe, nearer the tip, and is a long, curved hook extending nearly to the process at the upper angle of tip.

The species seems by no means common, even where it occurs. I believe the specimens were all taken at light and, if I mistake not, quite early in the season.

Xylomiges perlubens Grt.

1881. Grt. Can. Ent., XIII, 132, *Xylomiges*.

"♂ Allied to *rubrica*. Fore wings variegated with reddish and gray. Lines double, brownish, marked on costa by blackish dots. Orbicular pale, with brown center and blackish annulus, upright; reniform with an inferior stain, a curved reddish inner streak, indistinct outwardly. Veins blackish. T. p. line followed by white venular

points. S. t. line preceded by a deep reddish shade marked opposite the cell and again below vein 3. Terminal space blackish, with a gray apical patch. External margin dentate; fringes cut with pale. Hind wings and fringes pure white; a broken terminal line; beneath with a dotted extra-mesial line and discal spot. Primaries beneath with the terminal space whitish; subterminal space stained with brownish; a discal mark very near the dotted extra-mesial line which hardly reaches the margin. Eyes hairy; tibiæ unarmed; antennæ brush-like; abdomen tufted at base. Wings elongate. Thorax and head reddish brown; collar edged with gray; abdomen pale reddish fuscous. Expanse 39 millimetres. Washington Territory. Collected by H. K. Morrison."

I have not satisfactorily identified this species, which may be one of the forms related to *rubrica* in the same way in which *subapicalis* is related to it. It can not be the latter species from the description.

[An examination of the type in the British Museum proves that it nevertheless is my *subapicalis*.]

Xylomiges rubrica Harvey.

1878. Harv., Can. Ent., x, 58, *Graphiphora*.
1882. Grt., New Check List, 31, *Xylomiges*.
1887. Smith, Proc. U. S. Nat. Mus., x, 462, *Mamestra*.

Ground color a rather pale reddish gray, powdery. Head and thorax concolorous, collar very narrowly dark tipped, lateral margin of patagiæ narrowly black edged. Primaries with the median and basal lines marked by geminate black spots on costa; but only feebly traceable for the remainder of their course. Sometimes they are entirely obsolete, more rarely distinct and easily visible. T. a. line evenly outcurved, somewhat lunate between the veins. T. p. line rather even, defining lines only slightly irregular. In course it is outcurved over reniform and quite evenly oblique below. A vague median shade, marked at costa and hind margin, and sometimes darkening the cell between the ordinary spots. S. t. line distinct, whitish, sharply defined, preceded by a variably broad, but always distinct, black shade. A prominent black streak at base, not reaching the t. a. line. Terminal space blackish, except at apex, which is pale, creamy gray, variably prominent according as the specimen is light or dark; the veins crossing the darker portion white marked. Claviform small, concolorous, more or less outlined in black. Orbicular oblique, oblong, more gray than ground color, well or even prominently outlined in black. Reniform moderate, upright, centrally constricted on the outer margin, narrowly outlined in white, which is basally preceded by black. In color it is reddish, darkened inferiorly, the red shade extending outward to the s. t. line, sometimes defined inferiorly by a blackish shade between veins 3 and 4. A lunulate, black terminal line, followed by a pale line at base of fringes. The latter are dark, cut with creamy gray. Secon-

daries white, powdered with black, and with a narrow, dusky, terminal line. Beneath white, more or less black powdered, both wings with a more or less distinct broken outer line and discal spot.

Expands 35–37 millimetres=1.40 to 1.50 inches.

HABITAT: Sierra Nevada, Nevada County, Rafael County in May, California.

A somewhat variable, but very distinct species. It is sometimes almost uniform in color, the black basal dash and distinct, pale s. t. line being the only prominent features. From this it varies to a form in which the ground color is paler, more gray, the ordinary spots sharply defined, the space between veins 3 and 4 black filled, margining the reddish shade beyond reniform, which in turn extends to the creamy gray apical patch.

The harpes of the male narrow abruptly to a long, curved tip. There are two claspers, one long and curved, extending parallel with the narrowed tip of the harpes, the other at the base of the first, small and stout, only slightly curved.

The Nevada County specimens are in the U. S. National Museum (through C. V. Riley) and have a red number 335.

The paler specimens have the *Taeniocampa* habitus most strongly marked.

Xylomiges subapicalis Smith.

1887. Smith, Proc. U. S. Nat. Mus., x, 462, *Mamestra.*

Ground color rather dark ash gray, powdery. Head and collar concolorous. Collar with a narrow white line, surmounted by a fringe of black scales at tip. Primaries sometimes with a reddish tinge in the basal space and beyond the reniform. Ordinary lines distinct, not prominent, geminate. T. a. line outwardly oblique, outcurved between the veins. T. p. line rather evenly bisinuate, the inner defining line lunulate, the outer even. Basal line geminate, easily traceable, not prominent. A somewhat indistinct, even, median shade line. S. t. line pale, yellowish, prominent, somewhat sinuous, preceded by a rich, deep brown shade, emphasized with black above vein 4 and below vein 3. Claviform wide, concolorous, incompletely outlined in black. Orbicular upright, oval, white, narrowly black-ringed, and with dusky central powderings. Reniform kidney-shaped, upright, large, inwardly black-ringed, inferiorly dusky, else with a pale, often reddish, shade which extends outwardly to the s. t. line. This paler shade is inferiorly margined by a black filling between veins 3 and 4. Apical space more gray, terminal space else somewhat darker. A series of terminal lunules, followed by a pale line at base of fringes; the latter cut with yellowish. Secondaries white, somewhat black-powdered, with a punctiform exterior and lunate terminal dark line. Discal spot more or less obvious. Beneath white, black powdered. All wings with a distinct discal spot, a punctiform outer line and a series of terminal lunules.

Expands 36 to 41 millimetres=1.45 to 1.65 inches.

HABITAT: Sierra Nevada, Nevada County, Lake County, Placer County, in June, all in California; Washington.

This insect I described originally as a variety of *rubrica* and referred it to *Mamestra*. It has a distinct habital resemblance to some species of that genus; but the balance of characters is in favor of *Xylomiges*. The material now before me shows that we have a very distinct species, with constant characters, but with exactly the same general pattern of maculation. The ground color is always ash-gray and there is no gradation to the reddish tint of *rubrica*. The orbicular is broadly oval and upright in the present species, distinctively different from the elongate, oblique, oblong form in *rubrica*. The outer margin is also rather more dentate. The sexual characters are very similar to those of *rubrica*, the harpes in *subapicalis* terminating in a similar form, not so lengthily produced however at tip. The claspers are much alike and the differences are best shown by a comparison of the figures.

Several specimens are in the collection of the U. S. National Museum (through C. V. Riley), some of them with the red number 336. The principal variation is in the depth of the ground color and the consequent relative prominence of the darker maculation.

[This is *perlubens* Grote.]

Xylomiges ochracea Riley sp. nov.

Ground color dull luteous, more or less white-powdered and variably dusted with ocherous. Head varying from white to the darkest shade in the insect. The thorax varies in the same way. Collar tipped with luteous, fuscous, or even blackish, patagiæ dark margined. Primaries with veins white marked, the contrast greatest in the darkest specimens; costa also white in most specimens. Basal line geminate, black, included space white, the black lines rarely complete, sometimes reduced to a few scales; but always traceable. T. a. line geminate, black, included space white, outwardly oblique in three even outcurves; the black defining lines are narrow and often interrupted, the interior line sometimes scarcely traceable. T. p. line geminate, included space white; preceding line a series of blackish lunules, outer line a series of black scales merely. In course it is quite widely outcurved and then inwardly oblique, only a little curved, to the inner margin. The line is unusually near the outer margin, and through the yellow space beyond it is an ocherous shade line, in which is sometimes a series of black lunules defining the s. t. line; more usually, perhaps, these lunules are wanting, and the yellow shade alone marks the line. A series of black terminal lunules, beyond which the fringes are cut with a dusky shade. Claviform present, quite variable in size, usually paler than the ground color, but sometimes concolorous, margined by a pale line which is sometimes defined by an edging of black scales. Orbicular large, round, or oval; reniform upright, constricted centrally. The

spots are sometimes white, sometimes concolorous with a white annulus, sometimes yellow powdered, and more rarely with a blackish powdering. Usually there is a dusky, rarely black, patch preceding the t. a. line on inner margin; but in some specimens this is entirely wanting. Secondaries smoky with a dark discal lunule, a dusky followed by a pale median line, and a series of dusky preceded by paler terminal lunules. Fringes long, white, with a smoky basal shade. Beneath, primaries dusky to an extra median line, thence pale, whitish. Secondaries white with an irregular outer dusky line. All wings with a distinct, rather small, black or smoky discal spot.

Expands 27 to 35 millimetres=1.08 to 1.40 inches.

HABITAT: Alameda County, California, October and November.

A large series of specimens is in the U. S. National Museum (through C. V. Riley), many of them bred and in excellent condition. The species is unique in maculation and habitus, and is allied in wing form to *patalis*, in which the strongly retracted head, short thorax, and long abdomen also find the greatest resemblance.

Within a limited range the species is quite variable and is yet so characteristic that it can scarcely be mistaken. The sexual characters differ from all the other species and are nearest to the *patalis* type. The harpes are abruptly narrowed and bent toward the tip, which is somewhat dilated and has the margin inwardly fringed with spinules. The clasper is a single, moderately long, curved, acute hook, arising from near the middle of the harpe.

Dr. Riley has kindly allowed me to publish his species here, to make the revision more nearly complete.

Xylomiges patalis Grote.

1873. Grt., Buff. Bull., I. 144 pl. 4 Fig. 11, *Xylomiges.*
fletcheri Grote.
1888. Grt., Can. Ent. XX, 130, *Xylomiges.*

Head, thorax, and primaries pale, whitish or creamy gray, the median space of primaries more dusky, sometimes fuscous gray, more rarely with a yellowish tinge. Collar with a variably distinct fuscous line near tip. Patagiæ black at the base of the wings. Primaries with a fine black basal streak, sometimes faint or entirely wanting. Basal line marked by a dusky or blackish spot in the median space. T. a. line rather remote from base, outwardly very oblique and somewhat outcurved, reaching the inner margin close to the middle. It is dusky, single except on costa, and quite usually marked only by the contrast between the basal and median spaces. T. p. line geminate on costa, pale between the dusky median space and a dusky costal patch in s. t. space; below that single, marked by a series of costal dots or, quite usually, only by the dusky median, contrasting to the paler s. t. space. In course it is outcurved over reniform, then oblique and somewhat incurved to the hind margin very near the t. a. line. The median space

is thus very narrow at that point and, broadening to the costa, roughly V shaped. S. t. line punctiform, consisting of a series of interspaceal black spots. These spots are variably distinct, sometimes punctiform, and occasionally obsolete. In the latter case the terminal space is dusky. The spot opposite anal angle is often more or less yellow shaded. A series of small terminal lunules. Claviform small, black-ringed, concolorous with the median space, not prominent. Orbicular large, pale, oval, oblique, incompletely black-ringed, often fused inferiorly with the large, pale, upright, kidney-shaped reniform, which is very narrowly black ringed. Secondaries pale fuscous, whitish toward base. A vague discal spot and a more evident broken terminal line. Beneath, primaries smoky, white powdered toward outer margin, with a faint exterior line and a series of terminal lunules. Secondaries white, powdery, with large discal spot, an even exterior, and a narrow marginal dusky line.

Expands 30 millimetres=1.20 inches.

HABITAT: Vancouver; California, Los Angeles County, April, June, November; Alameda County, May, June, November.

Rather a common species, of which a large series is in the U. S. National Museum (collection of J. B. S. and through C. V. Riley), many of them numbered 248 in red ink.

The species varies but little. The ordinary spots are usually fused, and the median space is usually dusky. Rarely the maculation will be almost entirely obsolete, and from this point all intergrades to the normal type are found.

A typical specimen of *X. fletcheri* Grt., is in the Museum, received from Mr. Fletcher. It does not differ in the least from the normal *patalis*.

In sexual characters the species is unique. The harpes are centrally narrowed, then the tip gradually enlarged, somewhat lappet-like and inwardly fringed with spinules. The clasper arises near base, is single, stout, slightly curved, moderate in length and obtusely terminated.

Xylomiges tabulata Grt.

1878. Grt., Bull. U. S. Geol. Surv. IV, 181, *Xylomiges*.

"♀ Eyes hairy. Head and thorax in front whitish-gray; collar with a black line; a black line between the antennæ; front fuscous. Forewings gray, shaded with blackish. Ornamentation very like *Lithophane tepida*, for which this species may be mistaken, but the yellowish white abdomen is rounded, not flattened. The transverse lines are double; basal half-line dentate, consisting of a black inner line and pale outer shade. Basal space gray; subbasal space wide, blackish. T. a. line with the outer component line most distinct, pale-centered, upright, waved, dentate on submedian vein, running close to orbicular. The claviform spot large, narrowly and incompletely margined with black, with the orbicular whitish gray; orbicular not closed on median vein,

rounded, upright, ringed with black. A square blackish mark connects the claviform with the t. a. line. Reniform moderate, stained with reddish or ocherous, annulate with white and with an outer incomplete black ring. T. p. line denticulate opposite cell, with a wider submedian inward lunulation, pale gray, with faint inner black line, followed by a narrow blackish shade, widening on costa in subterminal space. Subterminal space whitish gray, with a squarish black dash on submedian fold before the line, which is near the margin, angulate, cut with black fine streaklets. The narrow terminal space is blackish, with a black interrupted terminal line; fringes blackish gray. Outer margin retreating to internal angle below vein 2. Secondaries whitish, with black discal dot, powdered with blackish or fuscous externally, and narrow, mesial, waved line, accentuated on veins. A distinct black terminal line; fringes white. Beneath, whitish; forewings somewhat fuscous; discal dots and faint, common, accentuated extradiscal line.

Expansion, 36 millimetres; Centre, N. Y., June (W. W. Hill, Esq.)."

I have seen the type of this species in Mr. Hill's collection, and it seemed to me a *Mamestra*, allied to *M. gnata*. It will, however, require a male to settle the matter positively and I leave the species in its present position awaiting further light.

MORRISONIA Grt.

1874. Grt., Buff. Bull., II, 53.

Eyes hairy; front smooth, with short stiff vestiture forming more or less obvious superimposed frontal tufts; tongue long and strong; palpi moderate, reaching the front and sometimes to its middle; antennæ of male pectinated, serrate and bristled, or simply ciliated. The thorax is rather short, quadrate, the vestiture consisting of flattened hair and scales; the patagiæ are well defined; a central divided crest is usually prominent anteriorly, less defined posteriorly. Abdomen with dorsal tufts, distinct in all save *bisulca*, and obvious even here. Legs unarmed, normally constructed. Primaries elongate, narrow with oblique outer margin and somewhat retreating hind angle, scarcely marked in *bisulca* but distinct in all the others. Secondaries proportionate.

The genitalia of the male in the majority of the species are after one type. The harpes are long, with an enlarged, trigonate tip, furnished with spinules inwardly, clasper simple, formed of one or two curved claw or hook-like processes. The differences between the species will be best explained by the figures.

The species have a *xyliniform* habitus, and come, structurally, near to *Xylomiges*, from which they differ in the divided thoracic crest, more evident dorsal abdominal tuftings and longer abdomen.

The strigate confused maculation is characteristic of the species thus far known.

As I regard this genus at present, it contains the species described

in it by Messrs. Grote and Morrison, the species recently described by myself, and *Mamestra mucens*, *bisulca*, and *confusa*.

Three distinct series are recognizable, based on the antennal structure of the male.

The first, with pectinated antennæ, contains *mucens*, *rileyi* and *bisulca*. In all of them veins 3 and 4 are both pale marked to the margin, least distinct in *bisulca*.

Mucens has the median lines all strongly dentate, the t. p. line becoming white and distinct through the submedian interspace, where it is usually preceded by a black or blackish spot. It varies from an even dull fuscous brown, very like *confusa*, to a much paler, dirty luteous ground color, rarely washed with fuscous brown, the s. t. space obviously washed with bluish white, extending both to the apex and the anal angle. The black shade before the t. p. line in submedian space becomes much more contrasting in paler specimens.

Rileyi is a smaller species than the preceding, with the maculation much more confused and indefinite. There is a longitudinal black shade through the center of the wing, which obscures all the normal lines.

In *bisulca* the median lines are marked only on the costa, the reniform is somewhat contrastingly white marked, the claviform prominent. The pale rays are obvious on veins 3 and 4; but hardly as well marked as in the other species. The outer margin is more oblique, the hind angle less retreating.

The second series, with serrated and bristled antennæ contains *vomerina* with its variety *evicta* and (probably) *infidelis*, which are also distinguished by having vein 3 only pale marked.

In *vomerina* and *evicta*, which Mr. Grote correctly refers as varieties of the same species, the ordinary spots are large and fused, discolorous.

Vomerina has the costal region gray, contrasting strongly with the blackish shade obtaining below the median vein.

Evicta has exactly the same maculation, but it is a more even bluish gray with a more or less obvious reddish brown and even ferruginous suffusion, the terminal space darker fuscous.

Infidelis is compared by Mr. Grote to *vomerina*, but the ordinary spots are not fused, and, inferentially, there is no such contrast between costal and submedian region, though it is said that a rich red brown shade extends outwardly, suffusing the wing.

The two remaining species have the antennæ of the male simple, merely ciliated, and veins 3 and 4 are both pale marked.

Peracuta is a rusty reddish gray form with whitish gray streaking, indenting veins 7 and 8, as well as 3 and 4. The ordinary spots are small, fused, flask-shaped, incompletely white ringed and with a rusty reddish shade through the center.

Confusa is dull fuscous brown, all the markings obscure. The ordinary spots are large, often confluent, sometimes scarcely traceable. The t. p. line is more or less white marked, and usually obvious through the submedian interspace.

Altogether the species are closely allied in some cases, yet not usually difficult of recognition. It is rather strange that Mr. Grote should never have recognized the strong bond between *confusa*, *mucens*, and his species of *Morrisonia*.

The genus is intermediate in character between *Xylomiges* and *Mamestra*, *bisulca* being most aberrant here and more like *Mamestra* in habitus. In sexual characters there is a general tendency toward *Mamestra*, most marked in *bisulca* and *peracuta*.

In tabular form the species separate as follows:

Antennæ in the male bipectinated, veins 3 and 4, pale marked to margin.
Dark fuscous brown to luteofuscous with lilac gray shading in s. t. space, reaching apex and anal angle ..... MUCENS
Smaller, basal space to t. a. line inferiorly black, the black shade extending through center of wing ..... RILEYI
Dark fuscous, claviform well marked, reniform white marked, blotchy ... BISULCA
Antennæ in the male serrated and bristled, a pale mark to the margin on vein 3 only.
Ordinary spots fused, discolorous.
Upper half of wing strongly contrasting with inferior half; the former reddish gray, the latter blackish brown ..... VOMERINA
The contrast not evident, inferior portion of wing but little darker than costal region ..... EVICTA
Ordinary spots not fused, finely ringed, separate, brown centered ..... INFIDELIS.
Antennæ of male simple, ciliate merely; veins 3 and 4, both pale to margin.
Primaries pale rusty brown with whitish streaks, secondaries dull fuscous, ordinary spots small, flask-shaped, fused, indistinctly white-ringed ... PERACUTA
Primaries dull fuscous brown, all the maculation vague; secondaries whitish with soiled outer margin; ordinary spots often fused, large, not flask-shaped, dark ringed ..... CONFUSA

Morrisonia mucens Hbn.

1816. Hbn., Verzeichniss, 243, *Septis*.
1823. Hbn., Zutr. III, 25 f., 415, 416, *Septis*.
1852. Gn., Spec., Gen., Noct., I, 142, *Xylophasia*.
1856. Wlk., C. B. M., Lep. Het., IX, 177, *Xylophasia*.
1861. H. Sch., Corr.-Blatt, II, 74, *Xylomiges*.
1873. Grt., Buff. Bull., I, 110, *Hadena*.
1874. Grt., Buff. Bull., II, 28, *Xylomiges*.
1879. Grt., Can. Ent., XI, 206, *Mamestra*.
1880. Grt., Can. Ent., XII, 117, *Mamestra*.

Ground color varying from dull luteo-fuscous to a dark fuscous brown, all the lines confused and very strongly dentate. Collar with a black central line, the patagiæ with submarginal black lines. Basal line geminate, black, interrupted, marked on costa. T. a. line geminate, fragmentary. T. p. line denticulate, widely curved over reniform, more or less evidently white marked, most obviously so in the submedian interspace. It is followed by a series of more or less evident, sometimes obsolete, interspaceal blackish dashes, which occasionally become fused into dusky shades above and below the pale cut veins 3 and 4. Beyond the t. p. line a more or less obvious pale gray shade extends to the apex and to the anal angle, less marked or entirely wanting in the dark

specimens. Fringes dark, pale cut on the veins. A black longitudinal basal line and one along inner margin. Claviform large, concolorous, faintly outlined; beyond it a blackish patch to the t. p. line, which in pale specimens is often the most prominent feature of the wing. Orbicular large, oblong or oval, oblique, concolorous, variably outlined, closely approaching, but not in any specimen seen by me confluent with the large reniform. This latter is also concolorous, kidney-shaped, more or less completely outlined. There is usually an obvious dusky shade between these spots. Secondaries whitish to fuscous, with soiled or brownish outer margins, a darker line at base of fringes. Beneath, whitish, powdery, with a blackish outer line and distinct discal spot on all wings.

Expands 32 to 35 millimeters; 1.28 to 1.40 inches.

HABITAT: Middle, Southern, and Central States; Texas (Belfrage), March 10 to April 2; central Missouri March 25, April 9 and 19.

This insect varies quite strongly in ground color, dark specimens, lacking the pale extra linear shade, being sometimes mixed with *confusa*. The black patch beyond the claviform is quite characteristic and is obvious in all the specimens I have seen. In the male, of course, no mixture is possible if the antennæ are referred to. In the female, the fused ordinary spots will generally separate *confusa*.

Ten specimens (Texas and central Missouri, collection of C. V. R. and J. B. S.), are in the National Museum collection, and from the dates given it is an "early bird." The male characters are much as in *confusa*, but the tip of harpes is more rounded, the upper angle pointed, inferior obtuse, the margin set with spinules its full length. The clasper is double, consisting of a moderately long, curved hook, with an obtusely pointed tip, and a very short, weak curved spur at the base of the longer process.

The species seems not rare in Texas, and the paler form is there most common.

Morrisonia rileyana Smith.

1890. Smith, Ent. Amer. VI, 212, *Morrisonia*.

Head, thorax, and primaries, in ground color, grayish white, with a ferruginous tinge. Palpi with a strong admixture of brown scales in their clothing. A rusty red brown line crosses the front below the antennæ. Collar tipped with powdery black. Patagiæ black, powdery. Thoracic tufts tipped with rusty. Primaries with a broad, black, longitudinal shade, running beneath the median vein to t. p. line, then broadening to outer margin, which it reaches below the apex. Along the inner margin an irregular, narrow, whitish border only is left. A ferruginous spot is in this black shade in the terminal space. Above this black shade the cell is filled with a rusty wash, in which the reniform is very faintly outlined by a narrow ring of ground color. T. a. line geminate, vague, diffuse; traceable in costal region only. T. p.

line geminate at inception, very oblique outwardly through costal region, becoming punctiform below and traceable through the black shade by pale venular dots. Secondaries white basally, with a broad powdery black margin outwardly; a vague discal lunule, an outer line of venular dots and a black, interrupted terminal line. Beneath white, with ferruginous, and a sparse black powdering; a common punctiform outer line, and a black discal spot, most distinct on secondaries.

Expands 31 millimetres; 1.25 inches.

HABITAT: Florida; Texas, March 27, Central Missouri, April 21.

Two specimens are in the Museum collection (C. V. R.), another from Florida, is with Mrs. Slosson. The species is the smallest of those referred here, and has a casual resemblance to *Homohadena*.

In genital structure this species is like *mucens*, in the form of the harpes as well as of the claspers.

Morrisonia bisulca Grt.

1881. Grt., Can. Ent. XIII, 230, *Mamestra*.

Ground color fuscous brown. Collar tipped by hoary scales. Primaries with whitish gray powderings along the costal and inner margins, most distinct in each case between the median lines, which are here visible. The veins are black lined, less obviously so on the costal series. Median lines obvious only on the costa and inner margin as geminate marks. The t. a. line is traceable for part of its course, indicating that it is strongly angulated. T. p. line but vaguely indicated near inner margin, outwardly produced on the veins. S. t. line consisting of a series of black spots in the interspaces, those between 2 and 3, 4 and 5, and 5 and 6, sending a shade inwardly across the s. t. space. A series of whitish dots at base of fringes, sending out a pale ray across the otherwise dark fringes. Veins 4 and 5, and less markedly 6 and 7, are accompanied by pale shades, extending through the terminal space. A prominent black basal dash through submedian interspace, having the claviform attached, and usually extending beyond it to the t. p. line. Orbicular elongate, narrowed, concolorous, outlined in black, the black lines uniting beyond the spot, forming a shade and again separating in forming the inner margin of the small upright reniform. This latter is outwardly indefinite, and is marked with white spots, distinct in all specimens I have seen. Secondaries pale whitish fuscous, with pale tipped fringes.

Expands 34 to 36 millimetres=1.36 to 1.48 inches.

HABITAT: Arizona.

A specimen of this species is among the unnamed material in the collection U. S. National Museum. The sexual characters are unique for the genus. The harpes are very slightly curved, and taper quite regularly to a somewhat obtuse tip, which is not spined or armed in any way. The clasper is a single, long, curved, corneous hook, with its broad and flattened base quite close to the base of the harpe.

The species is distinct from all the others by its comparatively broader, more trigonate primaries, the distinct, prominent basal streak, the small ordinary spots, the blotchy white reniform and by the series of subterminal black spots in the interspaces.

Morrisonia evicta Grt.

1873. Grt., Buff. Bull. I, 84, Pl. 2, f. 18, *Cloantha*.
1874. Grt., Buff. Bull. II, 16, *Actinotia*.
1874. Grt., Buff. Bull. II, 53, *Morrisonia*.
Var. *vomerina* Grt.
1873. Grt., Buff. Bull. I, 84, Pl. 2, f. 17, *Cloantha*.
1874. Grt., Buff. Bull. II, 16, *Actinotia*.
1874. Grt., Buff. Bull. II, 53, *Morrisonia*.
1879. Grt., Can. Ent. XI, 207, an var. pr. ?
1890. Grt., Revised Check List, 24 pr. var.

Ground color a powdery bluish gray with an admixture of brown. Head with a brown frontal line. Collar inferiorly pale, margined by a black transverse line. Thorax rich reddish brown, patagiæ with submarginal darker line. Primaries strigate, the median lines lost. A white spot at base of the wing. A longitudinal black basal line, surmounted with a yellowish shade, to which is attached the indefinite claviform, which is traceable as a rule to the location of the t. p. line. This line is usually indicated by venular dots and sometimes as a white line over the internal vein. A distinct brown terminal shade, starting at apex and regularly widening to the anal angle, the inner margin rigidly oblique. This brown shade is cut on vein 3 by a white tooth which accompanies it. A series of black terminal lunules. Ordinary spots large, fused, discolorous, more or less contrasting ocherous or even rusty brown, the lower defining line black. Secondaries smoky fuscous, with a discal spot. Beneath pale, powdery with reddish, with an outer line and discal spot on all wings.

The *evicta* form is as above described; in the variety *vomerina* the costal region is usually of the ground color or even paler, while all below this is blackish or deep dark brown, lightening a little along the inner margin.

Expands 33 to 35 millimetres=1.32 to 1.40 inches.

HABITAT: New York; New Jersey to Illinois; Middle and Central States. Illinois, April and October; Central New York, May 8 to 17.

Both forms are equally common in the same localities on the same dates. There has not been, in any specimen I have seen, any doubt as to which of the two forms it should be referred, but the difference in color below the costal region is absolutely all that offers, and I adopt Mr. Grote's suggestion as to their identity, the more readily as the sexual characters in the male are absolutely alike. The difference between the forms is parallel to that in *mucens*, where they are not distinguished by name.

Nine specimens of the two forms are in the National Museum collections (collections of C. V. R., J. B. S., and O. Meske).

The genital characters of the male are much as in *mucens;* but the clasper is very decidedly longer, and the little supplemental hook at base is different in shape.

[This is the same as *Xylophasia sectilis* Gn.]

Morrisonia infidelis Grt.

1879. Grt., Can. Ent. xi, 206, *Morrisonia.*

"♂ This name is based on a single male from Michigan, which is in good condition. Eyes hairy. Color of *vomerina* but more reddish brown. Collar pale and a pale spot at base of primaries; a black line edging the collar behind, thorax rich reddish brown. Costa paler at base, below median vein a rich red brown stain extends outwardly, suffusing the wing. Reniform L-shaped, the lower part open, brown filled, pointing to base of wing. This is surmounted by the upright part of the spot, which is small. Orbicular small, oblique, lying over and touching the extension of the reniform. The usual pale shade bordering vein 3; terminally the wing is a little darker. Hind wings pale fuscous with interlined white tipped fringes; beneath reddish gray, with common line marked by black scales on the veins. *Expanse,* 36 millimetres. Differs by the stigmata not being fused and pale, but finely ringed, separate and brown centered."

This species I have not seen. It is in none of the collections accessible to me, and from the description is somewhat allied to *peracuta.*

Morrisonia peracuta Morr.

1874. Morr. Buff. Bull. ii, 114, *Morrisonia.*

Ground color reddish gray, with paler and darker shadings. Collar with a distinct black transverse line, above which is an equally distinct white line. Patagiæ with a darker, submarginal line. Primaries with a narrow longitudinal black line at base, continued to the vague suggestion of a claviform. A blackish line along inner margin, nearly to middle. T. p. line single, brown, very strongly dentate or rather jagged. Beyond this the wing is darker except at apex and inner margin, cut by prominent gray streaks on veins 3 and 4, and 7 and 8. A brown shade through the cell, margined by a narrow superior black line, surmounted in turn by a whitish line which forms part of the defining marks of the small, confluent, flask shaped ordinary spots, which are incompletely outlined and with difficulty traceable. Secondaries dark, even smoky brown. Beneath dusky, primaries, dark on the disk, with a dusky margin.

Expands 38 millimetres=1.52 inches.

HABITAT: "Probably Texas, perhaps California."

There are two female specimens in the National Museum (collection of C. V. R.), evidently of the specimens before Mr. Morrison when describing, and marked "Type" by him. One of these has no locality label at all; the other is marked "California."

The male specimen from which the sexual characters were drawn came from the Tepper collection, and I have no note as to its locality.

The harpes in this species are suddenly constricted beyond the clasper, and a long tip, set obliquely, expands into a broad lappet, the inner surface set with spinules. The clasper is a straight, cylindrical, corneous process, with an abruptly pointed tip.

Morrisonia confusa Hbn.

1816. Hbn., Verzeichniss 243, *Auchmis*.
1823. Hbn., Zutr., III, ff, 495, 496, *Auchmis*.
1852. Gn., Sp. Gen., Noct., I, 142, *Xylophasia*.
1856. Wlk., C, B. Mus., Lep. Het., IX, 178, *Xylophasia*.
1873. Grt., Buff. Bull., I, 110, *Hadena*.
1874. Grt., Buff. Bull., II, 12, *Mamestra*.
1880. Grt., Can. Ent., XII, 118, *Mamestra*.

Fuscous brown with black powderings, very obscurely marked. Head with a dark frontal line, else somewhat paler. Collar usually pale inferiorly, crossed by a black transverse line, above which it is of the ground color. Patagiæ submargined with black. Primaries with the basal and median lines geminate, only partly defined, strongly dentate, the t. p. line sometimes white marked near internal margin. T. p. line well removed outwardly, consisting usually of a black, followed by a white line, both narrow and jagged, the white line often wanting or distinct only inferiorly, lightening the anal angle, and sending off spurs along veins 3 and 4. In the space beyond, there are two dusky shades, sometimes broken into spots or dashes. A series of black terminal dots. Fringes cut with pale, in perfect specimens somewhat scalloped. A black basal streak, to which is joined the rather small, black-ringed claviform, from which another line often extends to the t. p. line. A blackish streak along hind margin. A vague median shade, outwardly angulate over the reniform, reaching inner margin close to the t. p. line. Ordinary spots large, confluent, concolorous; orbicular sometimes paler, and reniform darker; pale ringed with a variably distinct and complete black margin. Secondaries whitish basally, darker outwardly, with a series of marginal lunules. Beneath pale, with reddish powderings and with a common outer line, discal spot distinct on all wings.

Expands 33 to 38 millimetres=1.32 to 1.52 inches.

HABITAT: Atlantic States; New York to Georgia, to Texas, to Colorado, and California. Kirkwood, Mo., April 4 and 20; New Brunswick, N. J., April 28.

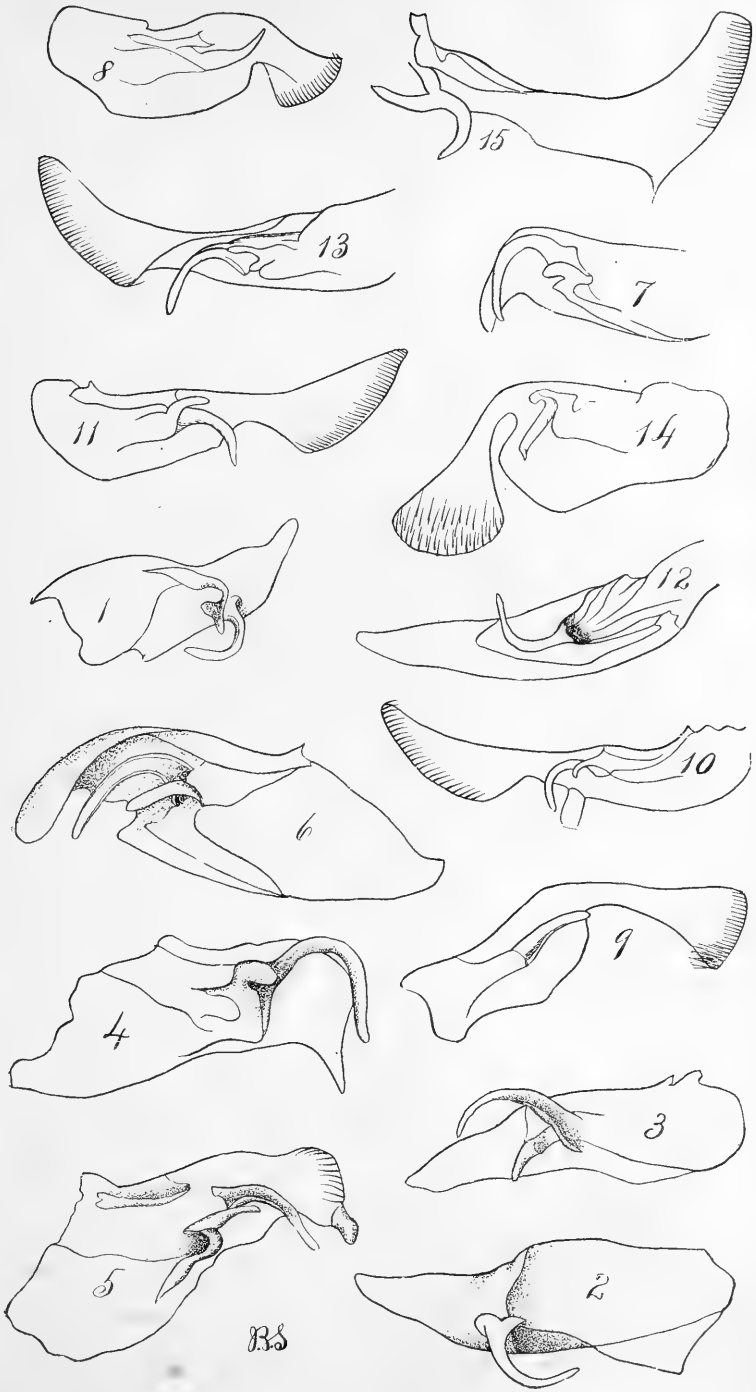
This obscurely marked species has a decided *Xyliniform* habitus, especially when a little rubbed. The females are somewhat narrower winged than the males, and in the material before me seem somewhat better marked. Sometimes the entire wing will be of an obscure fuscous brown, powdered with black, in which the maculation can be made out only with great difficulty.

A good series is in the Museum collection; among them a bred specimen (collection of C. V. R.) marked 302 L., April 5.

The harpes of the male have the tip much broadened, its upper angle truncate, the lower produced into a short spur. The margin is spinulose only on the superior half. The clasper is a single, rather short, strongly curved, pointed hook.

EXPLANATION OF PLATE.

1. Harpe and clasper of Xylomiges hiemalis.
2. Harpe and clasper of Xylomiges peritalis.
3. Harpe and clasper of Xylomiges crucialis.
4. Harpe and clasper of Xylomiges curialis.
5. Harpe and clasper of Xylomiges dolosa.
6. Harpe and clasper of Xylomiges rubrica.
7. Harpe and clasper of Xylomiges subapicalis.
8. Harpe and clasper of Xylomiges ochracea.
9. Harpe and clasper of Xylomiges patalis.
10. Harpe and clasper of Morrisonia mucens.
11. Harpe and clasper of Morrisonia rileyi.
12. Harpe and clasper of Morrisonia bisulca.
13. Harpe and clasper of Morrisonia evicta.
14. Harpe and clasper of Morrisonia peracuta.
15. Harpe and clasper of Morrisonia confusa.



GENITALIA OF XYLOMIGES AND MORRISONIA.

NOTES ON AVIAN ENTOZOA.

BY

EDWIN LINTON, PH. D.

(With Plates IV–VIII.)

The greater part of the material which is described in this paper was collected by the author in the summer of 1890 in the Yellowstone National Park, Wyoming.

A scientific expedition was sent out in July and August of that year by the Hon. Marshall McDonald, U. S. Commissioner of Fish and Fisheries, for the purpose of making a natural-history survey of the lakes and streams of the National Park. The author was instructed by the Commissioner to investigate specially the question of the excessive parasitism in the trout of Yellowstone Lake, and to ascertain if possible the source of infection.

The results of the study of that problem have been published in the Bulletin of the U. S. Fish Commission, Vol. IX, pp. 337–358, Pls. CXVII–CXIX, "A contribution to the Life History of Dibothrium Cordiceps, a Parasite infesting the Trout of Yellowstone Lake." In the search for the final host of the trout parasite several entozoa were found incidentally which were preserved for study.

The following birds were examined, with the results appended:

1. *Ardea herodias*, ♂, one bird examined. The stomach contained insect larvæ (*Hydrophyllus*, *Gomphus* and *Chironomus*), with a little vegetable material. No parasites.

2. *Clangula albeola*, ♀, one bird examined. The undigested food consisted mainly of *Ephemerid* larvæ. No parasites.

3. *Larus californicus*, three birds examined. The stomachs contained a few ribs and vertebræ of small fish. The entozoa were: *Dibothrium cordiceps*, three immature specimens, *D. exile* sp. nov., one specimen; *Tænia porosa*, one specimen, *T. filum*, several specimens; *Distomum* (?) *verrucosum* sp. nov., two specimens.

4. *Fuligula vallisneria*, ♀, one bird examined. The entozoa consisted of numerous specimens of *Tænia compressa* sp. nov.

5. *Oedemia americana*, four birds examined, one large and three smaller specimens; the entozoa found in the large bird consisted of two specimens of *Echinorhyncus striatus;* the three smaller birds yielded the following entozoa: *Distomum flexum* sp. nov., one specimen; *Epision*

plicatus gen. et. sp. nov., four specimens; *Tænia macrocantha* sp. nov., three specimens; *T. compressa* sp. nov., several specimens.

6. *Pelecanus erythrorhynchus*, four birds examined. The stomachs contained good-sized fish in different stages of digestion. All of them contained very numerous specimens of *Ascaris spiculigera* in the œsophagus and stomach. In the intestine of two of them the adult stage of *Dibothrium cordiceps* was found, thus furnishing proof that the pelican is a final host of the trout parasite.

The above specimens were collected from the 1st to the 10th of August, on the shores of Yellowstone Lake.

The description of a few specimens collected by Mr. P. L. Jouy at Guaymas, Mexico, in February, 1891, is also included in this paper. These consist of specimens of *Ascaris spiculigera*, numerous, from stomach and œsophagus of *Pelecanus fuscus; Echinorhynchus rectus* sp. nov., from a species of *Larus*; fragments of *Tænia*, probably *T. capitella*, from *Colymbus* sp.; fragments of *Tænia*, probably *T. fusus*, from *Larus*, sp.; fragments of *Tænia*, probably *T. larina*, from another species of *Larus*.

I have not included in this paper any account of the adult stage of *D. cordiceps* of the pelican, having already described it in the article cited above. Attention may be called here, however, to the occurrence of what I take to be immature specimens of *D. cordiceps*, in good condition, in the intestine of the California Gull. It is probable, therefore, that this bird may occasionally become the final host of the trout parasite.

One new genus was met with among the parasites of the duck, *Oedemia americana*. This genus, which I have named *Epision*, is characterized by a singular modification of the anterior part of the body into an organ for absorption and adhesion.

NEMATODA.

Filaria serrata sp. nov.

(Pl. IV, Figs. 1–4.)

The following description is based on a single specimen, a male, from the intestine of the hawk, *Circus cyaneus hudsonius*, Yellowstone Lake, Wyoming, August, 1890. It appears to be near *F. leptoptera R.*,* but differs from that species in some important particulars, especially in the character of the spicules. I, therefore, for the present, record it as a new species.

The length of the specimen is about 8 millimeters, the diameter, 0.2 millimeter. It tapers gradually and uniformly toward the anterior end. The posterior end is coiled into a helix and is provided with broad, lateral and muscular alæ. The spicules are two and very unequal; the longer one is about .3 millimeter in length, the shorter only about one-

* See Schneider, Monogr. der Nem. P. 97, Pl. v, fig. 8, and Von Linstow, Trosch. Archiv., 1877, p. 10.

tenth as long; the extremity of each is bent around into a short hook (Fig. 4). Lips, two, lateral, with three tooth-like processes on inner side of each. Pharynx short, and with what appears to be a chitinous ring at the base. The body is crossed by transverse striæ, which give the cuticle a segmented appearance, being sharply serrate on the margins in optical section. The transverse striæ are 0.008 millimeter apart.

The anal papillæ were not as satisfactorily made out as could be desired, but appear to have the arrangement shown in the diagram (Fig. 3). The papillæ on the left side are fungiform, with comparatively broad disks. Those on the left side and the four small post-anal papillæ near the caudal extremity were plainly seen, while those on the right side were made out by focussing down through the overlapping ala, and were not so satisfactorily seen.

Ascaris spiculigera Rudolphi.

(Pl. IV, Figs. 5–12.)

Diesing, Syst. Helm., II, 157, Revis. der Nem., 658.
Leidy, Proceed. Acad. Phila., 1858, p. 102; 1890, p. 411.
Schneider, Monogr. der Nem., p. 45; Pl. I, Fig. 14.
v. Linstow, Zoöl. of the Voyage of H. M. S. Challenger, Part LXXI, pp. 3, 4, Pl. I, figs. 5–7.

This nematode was found in immense numbers in the White Pelican (*Pelecanus erythrorhynchus*), Yellowstone Lake, Wyoming, August, 1890. Two birds yielded 820 specimens.

Two lots of this parasite from *P. fuscus* collected by Mr. P. L. Jouy, at Guaymas, Mexico, February, 1891, (National Museum acc. 24137, Nos. 971,974), have also been submitted to me for examination. These lots contain 45 and 102 specimens respectively, being in each case the number found in a single bird. I make the following extract from Mr. Jouy's letter:

> The gular pouch and stomach were infested with worms. They were found sparingly in the throat and pouch of the birds, becoming more abundant in the stomach, at the bottom of which they were a mass with the partially digested fish. A few of them were slightly attached to the skin of the pouch or stomach and required a slight pull to release them. No parasites of any kind were found in the intestines of this bird.

The largest females among the Guaymas specimens measured 34 millimeters in length and 1.5 millimeters in diameter; the largest males 28 millimeters in length and 1.5 millimeters in diameter. The smallest specimens measured 7.5 millimeters in length and 0.35 millimeter in diameter.

Following are the dimensions of two of the largest specimens:

	♀	♂
	mm.	*mm.*
Length	32.00	20.50
Greatest diameter	2.10	1.50
Diameter of body, anterior end	.55	.40
Diameter of head	.30	.25

In the adult worm the body is rather stout and dark colored, due to the contents of the intestine. Those found in the œsophagus were smaller and lighter colored than those found in the stomach. Moreover, they were attached to the mucous membrane of their host, leaving a small round pit when removed. The body is of nearly uniform size throughout, tapering a little more at the anterior than at the posterior end. The head is characterized by having a triangular spine-like interlobe in the intervals between the three proper lobes of the head (Fig. 6). Papillæ were observed near the anterior end of some (Fig. 6). They appeared to be more common on the females than on the males, but are variable in number and frequently altogether absent.

The œsophagus is slender and rather short. There is a short diverticulum beyond its union with the intestine; the latter also extends forward of the union with the œsophagus for a short distance as a blind sac.

In both the Guaymas and the Yellowstone specimens the females considerably outnumbered the males. The sexes are readily distinguished. The posterior end of the males is usually curved sharply and is provided with two long filiform spicules which, when fully extended, may curve almost into a circle. The spicules are of unequal length. When the spicules are not visible for any reason the males may still usually be recognized by the flattened surface near the posterior end, which ordinarily presents a grooved appearance between the retractor muscles of the spicules.

Bodies of the females frequently swollen in the region of the reproductive aperture, which is placed about the anterior third. This aperture in one of the adult specimens measured 0.75 millimeter in length and 1.25 millimeters in a direction transverse to the axis of the body. The posterior end of the female is cylindrical, pointed, and not recurved, as in the male. The ova measured 0.06 millimeter in diameter, the shell of the same being 0.005 millimeter thick. Some were observed in which segmentation had begun; both morulæ and gastrulæ were noticed. This was in the eggs from a Guaymas specimen.

My observations on the anal papillæ were made on a single adult male. Their disposition is shown in the diagram, in which the precise relative distances from each other are perhaps not exactly shown. There are, as is shown in the sketch (Fig. 10) six pairs of post-anal papillæ, symmetrically arranged. The four anterior of these pairs are distinguished by having a common disk. The two posterior pairs are without disks and the papillæ in each pair slightly removed from each other. The latter are smaller than the other pairs, and of the others the anterior pairs are the larger. The pre-anal papillæ begin opposite the anal aperture and extend in symmetrical rows along each side. They are a little closer together near the posterior end of the rows for about eight papillæ. In the specimen examined there were about twenty-six pre-anal papillæ in each row.

ACANTHOCEPHALA.

Echinorhynchus rectus sp. nov.

(Pl. IV, Figs. 13–17.)

Two specimens of Echinorhynchus, ♂ and ♀, were found among some fragments of Tænia collected by Mr. P. S. Jouy, at Guaymas, Mexico, February, 1891. The specimens were obtained from the intestines of *Larus* (*Chroicocephalus*) sp.

The body is smooth, fusiform, with its greatest diameter near the anterior end whence it tapers very gradually in both directions; proboscis nearly cylindrical, implanted obliquely or at right angles, armed with about twenty-four spiral series of hooks, about ten visible on one side in a single spiral, those on basal half straighter and more slender than those on distal half, base of proboscis for a short distance without hooks; sheath slender, a little longer than the proboscis; lemnisci slender, a little longer than the sheath.

Male, length 8.5 millimeters; testes two, oval, approximate, median; prostatic glands represented by a broad tubular organ into which ducts from the testes empty and which continues posteriorly in a large ejaculatory bulb, the genitalia ending posteriorly in an eversible copulatory bursa.

Female, length 9 millimeters, immature, no ova.

Following are the dimensions of the male:

	Millimeters.
Length	8.80
Anterior diameter	.45
Greatest diameter	.80
Posterior diameter	.45
Length of proboscis, (estimated)	1.80
Diameter of proboscis, anterior	.25
Diameter of proboscis, base	.22
Length of sheath	1.80
Length of lemnisci	2.00
Diameter of lemnisci	.10
Length of hooks	.09
Length of testis	.60
Breadth of testis	.35

The length of the proboscis was estimated; 1.4 millimeters was the length of the extended portion and 0.4 millimeter the length of the part still invaginated at the apex. In the female the length of the proboscis was 1.5 millimeters with 0.4 millimeter of apex invaginated; length of sheath, 2.2 millimeters; diameter of sheath, 0.3 millimeter at its widest part, near anterior, and 0.12 millimeter at its posterior end.

Several nucleated cells were observed in the bursa of the male; these were 0.04 millimeter in diameter and each contained a conspicuous nucleus 0.01 millimeter in diameter.

These specimens possess several points of agreement with *E. transversus* Rudolphi.

According to Dujardin the male of *E. transversus* has only one globular testis, while the testes of *E. rectus* are two in number.

Echinorhynchus striatus Goeze.

(Pl. v, Figs. 18–25.)

Diesing, Syst. Helm. II, 45, Molin. Sitzungsb, d. k. Akad. XXX, 143; Denkschr. d. k. Akad. XIX, 266, tab. VIII, Fig. 7.

Two small echinorhynchi (Figs. 22–25) from the Black Scoter (*Œdemia americana*) have been referred to the species *E. striatus*, although they are considerably smaller than the recorded specimens of this species. The specimens are both females, one with embryos and the other with large ovarian masses with no embryos. They were found in the intestine near the cœca, one cream-colored, the other orange yellow.

The bodies are conical, spherical in front with a constriction near the anterior end, echinate in front of constriction, behind the constriction the body is smooth, longitudinally striated and terminating in a blunt point. The proboscis is larger at the base than at the apex and is armed with hooks of nearly uniform size, so disposed that about eight may be counted in a transverse spiral on one side and twelve in a longitudinal row. The proboscis is partly withdrawn in each of these specimens, so that the neck can not be plainly seen. It appears, however, to be conical and unarmed.

The length of these specimens was about 3.3 millimeters. Other dimensions as follows:

	Millimeters.
Length of proboscis	0.60
Diameter of proboscis, apex	.12
Diameter of proboscis, base	.20
Length of sheath	.60
Diameter of body, anterior	.80
Length of hooks	.05

At a distance of 0.4 millimeter from the posterior end the diameter was 0.3 millimeter; 1 millimeter from the posterior end the diameter was 0.6 millimeter. One of the eight specimens contained embryos 0.14 millimeter in length and 0.03 millimeter in diameter; the other contained ovarian masses, ellipsoidal in shape and 0.14 by 0.06 millimeter in their two principal diameters.

These specimens agree with the following-described specimens in the shape and armature of the proboscis and in the spines on the anterior part of the body, but differ in their smaller size, conical shape, and the absence of spines at the posterior end.

HABITAT: *Œdemia americana*, intestines. Yellowstone Lake, Wyoming, August, 1891.

A small lot of Echinorhynchi consisting of six specimens, all males (Figs. 18–21), from another duck which appears to be *Œdemia americana*, not fully grown, agree in several important particulars with the foregoing and have been referred to the same species. These specimens vary in length from 2.5 to 5.5 millimeters. The smaller ones have cylindrical bodies with one and in one case two constrictions. The larger

specimens are somewhat fusiform. The anterior region of the body is rounded and echinate. The proboscis, especially of the larger specimens, the spines of the anterior part of the body, and the shape, number, and arrangement of the proboscis hooks agree closely with those of the first lot. There is, however, a slight difference between the larger and the smaller specimens in the shape of the proboscis and the number of hooks. In the smaller specimens the proboscis is less conical than it is in the larger and there appears to be a less number of vertical rows of hooks. The hooks toward the base of the proboscis are stouter than those near the apex.

The testes are oval, and, when not displaced by constrictions in the body, lie close together, even slightly overlapping at their contiguous ends, near the base of the proboscis sheath. In some cases the anterior constriction of the body forced the anterior testis forward beside the sheath.

The prostatic glands appear to be about four in number and are elongated and parallel.

The most characteristic feature of these specimens is the echinate posterior end. This, indeed, appears to be an echinate armature of the bursa. These spines are numerous, forty or more having been counted in two of the specimens. They are terminal, and, like those on the anterior part of the body, appear to be sagittate in some aspects.

Two specimens from this lot yielded the following measurements:

	mm.	mm.
Length	5.50	2.50
Diameter, anterior	.40	.35
Diameter, median	.85	.50
Diameter, posterior	.20	.20
Length of proboscis	.60	.60
Diameter of proboscis at base	.24	.15
Diameter of proboscis at apex	.18	.15
Length of proboscis sheath	.70	.60

The anterior testis in one specimen was 0.3 millimeter in length and 0.17 millimeter in breadth; the posterior testis was 0.28 millimeter in length and 0.15 millimeter in breadth.

TREMATODA.

Holostomum variabile Nitzsch.

(Pls. v, vi, Figs. 26–29, 30–32.)

Amphistoma macrocephalum Rudolphi, Entoz., II, 340; Synopsis, 88, 354.

Holostomum variabile Nitzsch., Diesing, Syst. Helm. I, pp. 312–313, Revis. d. Myzhelm., p. 320; Von Linstow, Trosch. Archiv., p. 187, Compend. Helm., p. 103; Wedl, Sitzungsb., XXVI, p. 252–253, Pl. I, 18; Molin, Denkschrift. d. Kais. Akad., XIX, pp. 194–195, Pl. I, 6, 7; Brandes, Monograph d. Holostomidæ Zoöl. Jahrb., 1890, p. 590, Pl. XLI, figs. 1, 8, 9.

Holostoma macrocephalum Creplin, Dujardin, Helm., pp. 368–369.

Holostoma macrocephalum (Rud.), Olsson, Bitrag till Skand. Helm., p. 31.

Body divided into a shorter anterior and a longer posterior part by a profound constriction. Anterior part of body subglobose, variable, aperture transverse; posterior cylindrical, curved, slightly attenuate. Reproductive aperture terminal, circular, surrounded by an ample muscular border and with a central, obconical, protractile part.

Length, 3.7 millimeters.

The foregoing is a brief synopsis of the superficial characters of my specimens and differs in some particulars from the descriptions of *H. variabile* given by Diesing and others. For example, the species is usually described as being bilabiate and gaping at the apex. My specimens are so much contracted that this character, while not contradicted, is not manifest.

This peculiar entozoan has been found infesting a number of species of raptorial birds. Von Linstow has noted its occurrence in twenty-four species distributed among the following genera: *Nyctale*, *Ulula*, *Ægolius*, *Surnia*, *Bubo*, *Strix*, *Circus*, *Pernis*, *Buteo*, *Aquila*, *Circaëtos*, *Pandion*, and *Falco*. (Compend. Helminth.)

The following account is based on four specimens from the intestines of *Circus cyaneus* var. *hudsonius* collected near Yellowstone Lake, Wyoming, August, 1890. The specimens when studied were all alcoholic, no observations having been made on the living worms.

Two of the specimens furnished the following measurements:

	mm.	mm.
Length	3.70	3.60
Length of anterior, subglobular part	.60	.80
Diameter of anterior part	.90	.80
Diameter of posterior part, median	.70	.80
Diameter of posterior end	.40	.45
Diameter of posterior aperture	.15	.12

The ova measure 0.05 millimeter in length and 0.065 millimeter in breadth.

The bodies of all the specimens are bent abruptly at the constriction and the posterior portion is also more or less curved. From the examination of a series of sections it was ascertained that the anterior portion is bent abruptly backwards so that its dorsal region approximates the dorsal region of the posterior part. This is effected by some strong fascicles of longitudinal muscles which have their principal development in the dorsal and dorso-lateral regions of the body.

Anatomy.—The following observations on the anatomy of this species are based on a series of longitudinal sections made parallel to a dorso-ventral plane, and stained with borax carmine.

In the anterior, subglobular division of the body there are three muscular organs placed near together (Fig. 29, *m. ph. s.*) which represent the mouth, pharynx, and ventral sucker. The first and third of these appear, in the sections, to open into the interior of the mass, since that part of the body is much folded together and contracted. This part of the body appears to be capable of expanding into a comparatively large suctorial or, more properly, absorbing surface.

The anterior or oral sucker is 0.15 millimeter in its antero-posterior diameter and 0.12 millimeter in its dorso-ventral diameter; the diameter of the passage between its muscular walls 0.02 millimeter. The walls of the pharynx are almost contiguous with those of the oral sucker. Its length is 0.12 and its depth 0.09 millimeter. The length of the ventral sucker is 0.12, and its depth 0.21, and the thickness of its walls 0.06 millimeter. The œsophagus is short, at first deflected, ventrally, then divides in front of the ventral sucker. The two branches at first diverge, then turn back towards the constriction. In these sections they could not be traced into the posterior region of the body. The walls of the pharynx, and particularly of the intestinal crura, are ciliated.

The greater part of the anterior division of the body is filled with what I interpret to be the vitelline glands. The latter also occupy the anterior and ventral region of the posterior division of the body. A folded portion which occupies a central position (Fig. 29, *y*) appears to answer to Molin's "*lembo roversato.*" It contains many nucleated cells and would appear from its position and structure to be an organ for absorption. A lobed body (Fig. 28, *x*) is situated in the anterior division near the constriction and towards the dorsal side. This is evidently the "*kugliger korper*" of Von Linstow, mentioned in his anatomy of *Holostomum gracile.* The lobes of this body are composed of minute cells which are about 0.004 millimeter in diameter. The irregular cleft which in these sections marks the limits of the lateral borders extends almost to the constriction (Figs. 28–29).

The reproductive organs, with the exception of a part of the vitellaria, lie in the posterior division of the body. The extreme posterior end of the body consists of a muscular suctorial organ with thick walls. In the middle of the base of this organ the uterus terminates in a prominent papilla (Fig. 28, *p*). On the dorsal side of the body, immediately in front of the bursa, is the pyriform cirrus pouch, with a duct leading therefrom and emptying into the uterus about the base of the papilla (Fig. 28, *c*). There does not appear to be any cirrus and the pouch probably functions as an ejaculatory organ. In front of the cirrus pouch, and occupying a position about on the median line, is the posterior seminal receptacle. The testes are large, extending from near the base of the bursa to near the middle of the posterior division of the body, and taking up three-fourths of the dorso-ventral diameter. They reach the body-wall dorsally and laterally, but not ventrally. A vas deferens lies along the ventral side of the testes, between them and the uterus. The shell gland, together with a portion of the germ duct and the main vitelline duct and the beginning of the uterus, lies between the two testicular lobes (Fig. 28).

The ovary is single, lenticular, and lies in front of the testes, at about the middle point of the body. (Fig. 28 *o.*) It is inclined forward at its ventral end and backward at its dorsal end. Laterally it reaches

almost to the walls of the body, being separated from them by a thin layer of the vitellaria, and some strong muscle-fascicles from the anterior division of the body. The cells of the ovary measure 0.02 millimeter in diameter. The nuclei measure 0.007 millimeter in diameter, and in some a nucleolus was observed. Between the ovary and the anterior testis is a space which contains what I have called in the explanation of Fig. 28, the anterior seminal receptacle, the vagina and the beginning of the oviduct. The sections showed the presence of a duct here which appears to communicate with the exterior dorsally and which I have interpreted as the vagina, or canal of Laurer. (Fig. 28 *v.*) The oviduct originates at the dorsal end of the ovary, passes along the dorsal region between the anterior testis and the body-wall, enters the space between the testes where, after receiving the main vitelline duct, it enters the shell-gland and emerges in the ventral region as the uterus. The uterus, from its origin about the ventral side of the anterior testis, proceeds anteriorly where, in the space in front of the ovary the ovules are for the most part collected. The uterus here appears to consist of several voluminous folds, but the walls are thin and the ova appear in the section to lie in an illy-defined cavity. The posterior prolongation of the uterus was proved by tracing ova along the ventral region, where they were found in the posterior portion of the uterus near where it terminates in the posterior bursa. The walls of the uterus near its posterior end are thick and muscular and lined with cilia.

The vitelline glands are voluminous organs, occupying the anterior part of the body proper, where they fill the peripheral regions, having a further development in the anterior division of the body. A broad ventral branch extends backward almost to the posterior end. Two vitelline ducts extend along the ventral side of the body above the ventral vitellaria. Opposite the space between the two testicular lobes each gives off a duct which unite in a common duct between the two testes. This latter duct joins the oviduct behind the shell-gland. (Fig. 28 *yd.*) A cross section of the common vitelline duct presents a curious reticulated appearance, due to aggregation of the food yolk into elongated spheroidal masses of minute fat globules.

Distomum (?) verrucosum sp. nov.

(Pl. VI, Figs. 33–35.)

Two singular specimens from the intestines of the California Gull (*Larus californicus*) possess so many characters peculiar to themselves that I do not hesitate to regard them as representatives of a hitherto undescribed species, although on account of the paucity of material I am able to give but few points in their anatomy.

One of these specimens was coiled in a spiral as shown in Fig. 33, the other, Fig. 35, had lost a part of the body. That the two belong to the same species admits of no doubt.

The length of the fragment was 5.5 and of the entire specimen about 8 millimeters.

The body, behind the ventral sucker, appears to be subcylindrical, but is characterized by a profound groove on the ventral side, the edges of which consist of ventro-marginal flaps, which separate anteriorly on either side of the ventral sucker, in front of which they disappear. Neck flat on ventral side; mouth subterminal, large; ventral sucker near anterior end, short-pedicilled, circular, with thickish, prominent or reflected border; reproductive aperture in front of ventral sucker. Surface of body, from and including ventral sucker, smooth; remainder of body on back and sides more or less tuberculous; tubercules specially abundant on dorsal region just back of ventral sucker. The ventral surface is crossed by transverse rugæ, which, together with the disk of the ventral sucker, are minutely tuberculated. It is probable that the ventral surface in life does not appear to be grooved, but rather flat.

The fragmental specimen had the following dimensions in millimeters: Length, 5.5; diameter of neck, 0.4; diameter behind ventral sucker, 0.7; ventral sucker, 1.4 back of head; diameter of mouth, 0.4; diameter of vetral sucker, 0.6. A central tubular organ containing a coiled duct, presumably the uterus, extended back from the posterior end of the fragment 1.4 millimeters. This tube was 0.27 millimeter in diameter and the contained duct 0.06 millimeter in diameter. The thin walls of this tube were minutely roughened. The tubercles on the surface of the body are short and blunt and measure 0.025 millimeter in length. In most cases their breadth equals their length.

The imperfect specimen was stained and cut into longitudinal sections. The specimen is immature and the sections do not show much that can be made out definitely. The alimentary canal is bifurcate, but otherwise there is little resemblance to any Distomum or even Trematode with which I am familiar. The reproductive aperture lies in a groove on the ventral side of the neck in front of the ventral sucker, and a little forward of the bifurcation of the intestine. A series of oval masses, which lie along the dorsal region are probably the vitellaria. The exact nature of the cylindrical tube with its contained, convoluted duct, which protrudes from the center of the posterior end of the fragment was not determined.

The neck of the entire specimen was much flatter than the body proper, which was subcylindrical, *i. e.*, compressed so that its dorso-ventral diameter was less than its lateral diameter. The diameter, lateral, of the head was 0.3 millimeter; the breadth of the neck midway between the mouth and ventral sucker was 0.7 millimeter; greatest diameter of the body, 0.8 millimeter; diameter of the posterior end, 0.3 millimeter; length of the spiral, 2.3 millimeters; entire length of specimen, 8 millimeters. Two sinuous dark-colored lines traverse the back along the posterior two-thirds of the body. These are probably the genitalia showing through the dermis.

HABITAT: *Larus californicus*, intestines, Yellowstone Lake, August, 1890.

Distomum flexum sp. nov.

(Pl. VI, Figs. 36–44.)

It has been found necessary to make a new specific name to accommodate a small Distomum from the black scoter (*Oedemia americana*), although its near relationship to at least two described forms is quite evident. It agrees very closely with Diesing's *D. baculus;* indeed, if Diesing's description alone were employed it could be readily referred to that species. Von Linstow, however, in his account of *D. baculus* (Trosh. Archiv. 1877, p. 183, Pl. XIII, Fig. 15), neither mentions nor figures any cervical spines. It is not at all probable that such a careful observer as he would neglect to mention such an important character, especially as in his figure of *D. spinulosum* (l. c. Fig. 14), the cervical spines are shown. The latter species must be excluded on account of the smaller number (twenty-two) of the oral spines.

A Distomum discovered and described by Olsson from *Larus marinus*, and called by him *D. pseudoechinatum* (Bitrag till Skandinaviens Helminthfauna, p. 21, Pl. IV, Figs. 45–49) resembles my specimen in the spinous margins of the neck and in the general appearance of the head. It is much larger, however, being 8 millimeters in length, and has, moreover, only about twenty oral spines.

The body of this specimen is subcylindrical and linear; the neck is attenuate anteriorly, concave on the ventral side, just back of the head, and armed with spines along the margins; the head is transversely reniform and provided with a crown of about forty-five spines; the mouth is terminal and prominent, its aperture circular; the ventral sucker is about twice the diameter of the mouth and sessile; pharnyx elongated; genital aperture in front of ventral sucker; testes two, oval, midway between ventral sucker and posterior end; ova few and large.

Length, 2.5 millimeters.

Other dimensions are:

	Millimeters.
Diameter of head	.30
Diameter of neck	.19
Diameter of the body at the ventral sucker	.40
Diameter of body near posterior end	.26
Diameter of ventral sucker, internal	.16
Diameter of ventral sucker, external	.28
Diameter of oral sucker, internal	.09
Diameter of oral sucker, external	.13
Length of testes	.30

The oral hooks are flat and broad, and the larger ones 0.055 millimeter in length, and 0.01 to 0.015 millimeter in breadth.

The cervical spines are triangular and 0.015 to 0.02 millimeter in length. These spines appeared to be only in the margins of the neck, although possibly they may extend dorsally for a short distance.

The front edge of the ventral sucker was 0.5 millimeter from the an-

terior end. The pharnyx was 0.1 millimeter in length, and 0.06 millimeter in breadth, its anterior end 0.03 millimeter back of the oral aperture.

The ova were few, about nine were counted, and were relatively large, 0.09 millimeter in length. Several of them were observed to be undergoing segmentation (Figs. 39 and 40).

The ovary is situated in front of the testes, and near the anterior one; the vitellaria are voluminous, occupying the posterior part of the body behind the testes and the margins of the body nearly as far forward as the ventral sucker.

HABITAT: *Oedemia americana*, intestines, Yellowstone Lake, August, 1890.

CESTODA.

Dibothrium cordiceps Leidy.

(Pl. VI, Fig. 45.)

Larval (encysted) stage in *Salmo mykiss*.

Leidy, Hayden's Report on Geol. of Montana and Adjacent Territory, 1871, p. 381, 382.

Linton, Bulletin U. S. Fish Commission, 1889, Vol. IX, pp. 65–79. Pl. XXIII–XXVII.

Adult stage, in *Pelecanus erythrorhynchus*.

Linton, Bulletin U. S. Fish Commission, 1889, Vol. IX, pp. 337–358. Pl. CXVII–CXIX.

I have referred to this species a small lot of immature specimens, belonging to the genus Dibothrium, obtained from the intestine of the California Gull (*Larus californicus*), Yellowstone Lake, August, 1890. Five specimens were found in one gull and one in another.

The specimens have the following characters: Bothria lateral; body rather thick, subcylindrical in front, compressed elsewhere, tapering posteriorly, crossed by exceedingly fine striæ.

The dimensions of an average specimen are as follows:

	Millimeters.
Length	7.00
Diameter of head	.32
Diameter of body, anterior lateral	.65
Diameter of body, anterior marginal	.40
Diameter near posterior end	.20

There is no indication of reproductive organs.

The species *D. cordiceps* is not excluded by any characters yet developed in these specimens. Satisfactory identification, however, is always difficult in forms like these, which may assume such diverse shapes with different degrees of contraction.

On account of the small size and immature condition of these specimens it may be inferred that they had not been in the intestine of the gull very long. It does not follow, therefore, that they would reach maturity in this host. So that even if the specimens have been correctly identified in this case it can not be said positively that the gull is a proper final host of *D. cordiceps*.

The adult stage of *D. cordiceps* was found in the intestine of *Pelecanus erythrorhynchus*, Yellowstone Lake, August, 1890, an account of which was published by the author in a paper entitled "A Contribution to the Life-history of *Dibothrium cordiceps* Leidy." Bulletin of the U. S. Fish Commission, 1890, Vol. IX, pp. 337–358, Pl. CXVII–CXIX.

Dibothrium exile sp. nov.

(Pl. VI, Figs. 46–48.)

Head oblong, tapering both anteriorly and posteriorly; bothria elongated, lateral with rather thin lips; neck long and slender; the first segments twice as broad as long, this proportion continuing without much change, except that the breadth increases rather faster than the length, until the median region is reached where the segments are squarish and even a little longer than broad; the posterior segments are rectangular, the length being a little in excess of the breadth. The segments throughout are characterized by considerable regularity and distinctness and the strobile by its nearly linear form throughout.

The single specimen obtained had the following dimensions in alcohol.

	Millimeters.
Length	153.00
Length of head	1.50
Greatest breadth of head	.60
Thickness of head	.20
Distance from head to first segment	10.00
Breadth of neck	.30
Thickness of neck	.16
Length of first segments	.28
Breadth of first segments	.50
Length of posterior segments	.85
Breadth of posterior segments	.80

The length of the living specimen was 160 millimeters.

The genitalia have not yet developed. Careful search was made in several of the posterior segments which had been stained with borax carmine and made transparent in oil of cloves, without revealing any genitalia whatever. The interior of the segments is filled for the greater part with granular protoplasm. These granules were beginning to gather into denser masses along the median line rather towards the posterior part of the segments. It may be inferred therefore that the genital apertures are median in this species, although it can not be proved from this specimen.

HABITAT: *Larus Californicus*, intestines, Yellowstone Lake Wyoming, August, 1891.

EPISION gen. nov.

('Επισείων, a pennant).

Anterior end of body (head) lamellate, more or less crispate, deflected.

Body proper, tæniæform, segmented, segments not distinct.

Reproductive apertures lateral (?).

Epision plicatus sp. nov.

(Pl. VI, Figs. 49–53.)

Anterior part of body (head) a lamellate unsymmetrical organ, which consists of an elongated auricular pointed flap, deflected marginally and forming an angle with the body proper, and a shorter rounded lobe at the opposite margin. This leaf-like organ is more or less crimped or folded, especially near the shorter lobe, and on the anterior edge; it is crossed by fine transverse lines, which upon enlargement appear due to a segmented condition of the organ; two pairs of vessels rise near its extreme tip and are continuous with the longitudinal vessels of the body proper. Body nearly linear, flattened; segments beginning immediately behind the head, not distinct. Reproductive organs rudimentary in specimens examined, but from their position along the median line of the strobile, and their resemblance to similar stages of development in the *Dibothriidæ*, it is probable that the reproductive apertures are median.

Longest specimen, 23 millimeters in length and 1.5 millimeters in breadth.

HABITAT: *Oedemia Americana*, intestines, Yellowstone Lake, Wyoming, August, 1890.

The foregoing description is based on four specimens from the Black Scoter, the largest 23 and the smallest 6 millimeters in length. The breadth of the head of the larger specimen was about 3.2 millimeters, breadth of the body near the head 1 millimeter, and the length of the rather indistinct segments near the head 0.2 millimeter; greatest breadth of the body 1.5 millimeters; near the posterior end the breadth decreased to about 0.8 millimeter.

Following are the dimensions in millimeters of the smallest specimen: Length, 6; breadth of head, 1.8; length of head, 0.7; breadth of body near head, 0.35; breadth of body, posterior, 0.55.

The segments, which are rather indistinct, appear as if in pairs, or rather each is divided into two nearly equal parts by a faint transverse line.

The head is finely serrate on its margins, and presents a minutely segmented appearance when magnified. It is therefore not to be regarded as homologous with a scolex, but rather as the anterior portion of the strobile modified into an absorbing and adherent organ.

None of the specimens had reproductive organs developed sufficiently to fix the systematic position of these singular forms. Sections made from a series of posterior segments of a medium sized specimen show that there is no distinct segmentation in the inner portions of the strobile. The genitalia are represented by small, oblong clusters of granules lying transverse to the axis of the body and crowded together along the median region of the body. There are no external apertures, but the arrangement of the incipient genitalia, and of the longitudinal muscle fibers and the longitudinal vessels, as seen in these sections, indicates relationship with the *Dibothriidæ*.

Tænia sp. *Fragments not certainly identified.*

(Pl. VII, Figs. 54–58.)

Several fragments of *Tænia* from *Larus* sp. and *Colymbus* sp., collected at Guaymas, Mexico, by Mr. P. L. Jouy, February, 1891, have been referred to me for examination by the U. S. National Museum.

The fragments are without scolices, which makes the matter of identification uncertain.

I append, however, the following descriptive notes on these fragments.

I. Fragments of *Tænia* from *Colymbus* sp., Museum No. 4930 collector's No. 972 (Figs. 54, 55).

Mr. Jouy's notes on this lot are: "972. Parasitic worms from intestines of *Colymbus* sp. ♂ juv. The throat and stomach of this bird were empty and these specimens, apparently of a tapeworm, were found in the lower intestine."

The fragments appear to belong to the same strobile; the longest measures 115 millimeters, and the next longest 65 millimeters. The aggregate length of the fragments is about 200 millimeters. The largest proglottides are about 2 millimeters broad and 1 millimeter in length. The youngest segments are 0.75 millimeter in length. 1.2 millimeters in breadth, and 0.7 millimeter in thickness. Color of the alcoholic specimens, pinkish yellow, or faint rose. The segments are rounded on their anterior corners, posterior corners blunt and slightly projecting. Reproductive apertures all on one margin about the middle of the segments. Cirri, not seen projecting, but appear to have rather large diameter. Sometimes one margin of a segment projects about its middle point. This projection is on the margin opposite the one bearing the genital form.

The ripe segments contained ova which were inclosed in an outer pellucid envelope measuring from 0.09 to 0.12 millimeter in diameter, and containing an embryo 0.06 to 0.07 millimeter in diameter, the spines of which were about 0.02 millimeter in length.

These fragments very probably belong to the species *T. capitellata* Rudolphi or to an undescribed closely related species.

II. Fragments of *Tænia* from *Larus* sp. Museum No. 4931. Collector's No. 973 (Fig. 56).

Upon these Mr. Jouy makes the following note: "973. Parasitic worms from intestines of black-backed gull, *Larus* sp. There are apparently two kinds of worms from this specimen, but they are all taken from the intestines, the throat and stomach of the bird being clean and empty."

The longest fragment measures 155 millimeters in length. The other fragments are 80, 30, and 18 millimeters, respectively. The 80 and 30-millimeter fragments belong to the same strobile, and the 18-millimeter piece belongs to the 155-millimeter strobile.

In the longest specimen the last segments were 0.5 millimeter in length and 1.5 millimeters in breadth. The length of the first distinct segments was 0.5 and the breadth 0.2 millimeter. The anterior end for about 8 millimeters was attenuate and without evident segments. The first evident segments were a little more than twice as long as wide. The reproductive apertures are all on one margin, about the middle of the segments, somewhat prominent with thickened, protruding borders. The color of the alcoholic specimens is yellowish white. Segments somewhat like those from *Colymbus* in outline but not so thick, and rather more regular; strobile in general more delicate.

T. fusus Krabbe is suggested by these fragments.

III. Fragments of *Tænia* from *Larus* sp. Museum No. 4932. Collector's No. 975 (Figs. 57, 58). Mr. Jouy's note on this lot is as follows: "975. Parasitic worms (tapeworms) from the intestines of gull *Larus* (*Chroicocephalus*) sp. ♂. The throat and stomach of this specimen also clean and empty."

This lot consists of several fragments belonging to about three strobiles. The longest fragment measures 18 millimeters in length. The aggregate length of the fragments is about 140 millimeters. Anterior segments funnel shape, succeeding segments much crowded, and much broader than long; posterior segments squarish or rounded, separating easily from the strobile, about 1 millimeter in length and 0.6 millimeter in breadth. Reproductive apertures alternate and apparently regularly so; apertures near anterior end of segment. Ova spherical with thin walls, containing embryos. Diameter of external shell, 0.05 millimeter; diameter of embryo, 0.03 millimeter; length of spines, 0.01 millimeter. Some of the ova have thin, somewhat wrinkled shells; some also have what appear to be small curved hooks over the surface (Fig. 58). The specific determination of these fragments is not certain. In some particulars it agrees closely with *T. larina* Krabbe. All of these Guaymas fragments contained numerous small granular bodies, the largest of which measured 0.025 millimeter in greatest diameter, although usually smaller than that. In oil of cloves these particles frequently showed a concentric structure. They dissolve in acetic acid, but with difficulty. Brisk effervescence was not obtained even with heated hydrochloric acid. This character is in marked contrast with the behavior of the calcareous particles in the Yellowstone Lake specimens, where brisk effervescence followed treatment with acetic acid.

Tænia porosa Rudolphi.

(Pl. VII, Figs. 59–71.)

Rudolphi, Entoz. Hist. III, 190, Pl. X, 1; Synopsis 168 and 529, Pl. III, 7, 8. Dujardin, Hist. Nat. des Helm, 561. Diesing, Syst. Helm. I, 546; Sitzb. XIII, 610; Sitzb. XLIX, 415; Krabbe, Bitrag til Kund. orn Fugl. Bænd., 260, 261, Pl. I, 10–13.

Head subglobose, bothria somewhat circular with a thick border; proboscis cylindrical, armed with from twelve to fifteen hooks, which are

0.12 millimeter in length and straightish; neck short; first segments very short, subsequently variously longer and narrower, often infundibuliform; posterior segments on longest strobiles, squarish and transversely wrinkled; genital apertures irregularly alternate, cirrus short, opening near anterior edge of margin and directed forward; ova with a double envelope; length of embryonic hooks, 0.35 millimeter. Largest specimen measured while living, 120 millimeters in length and 2.5 millimeters in greatest breadth. Greatest recorded length hitherto, 100 millimeters.

HABITAT: *Larus californicus*, intestine, Yellowstone Lake, on different dates in August, 1890.

I refer to this species several Tænia, which, while presenting some differences among themselves that are difficult to reconcile with each other, do not, at least with the material at hand, appear to me to justify their separation into distinct species.

But one specimen with ripe proglottides was found. This was associated with several specimens of *T. filum* collected on August 2, 1890, and had the following dimensions and characteristics:

	Millimeters.
Length	110.00
Diameter of head	.46
Length of head	.30
Length of proboscis	.38
Diameter of proboscis	.11
Diameter of crown of hooks	.19
Length of hooks	.12
Diameter of neck	.35
Length of anterior segments	.20
Breadth of anterior segments	.25
Length of posterior segments	2.00
Breadth of posterior segments	2.50

The above dimensions are from measurements of an alcoholic specimen. The living worm measured 120 millimeters in length. The diameter of the proboscis immediately behind the hooks and at base was 0.09 millimeter; at apex and in middle, 0.11 millimeter. The posterior segments became dilated in alcohol. They were subglobose, being swollen with the contained embryos. The hooks on the proboscis were in a single circle and were fourteen in number. The complete set is probably fifteen. These hooks are uniform in size and shape, and are exactly 0.12 millimeter in length. The anterior segments are somewhat funnel shape, preceded, however, by very short beginning segments like transverse wrinkles; the median segments are somewhat rectangular, broader than long, and increasing in breadth toward the posterior end. Toward the posterior end of the strobile the segments have one or two wrinkles at the margin. The reproductive apertures are marginal near the anterior end of the segments and irregularly alternate, although often for a series of a dozen or more segments irregularly alternate. The cirri are short, smooth, and directed

forward. The embryos are well developed in the ripe segments, are enclosed in a double envelope, and their hooks are of three sorts (Fig. 66). Two of the hooks are broader than the other four, and two of the remaining four are more curved than the others. There is no material difference in length, however, each measuring about 0.035 millimeter.

Two specimens, 25 and 10 millimeters in length, respectively, and two fragments 6 and 8 millimeters in length, were obtained from another gull. The number of hooks in the larger was about fifteen, in the smaller twelve. The hooks agree in shape and size with those of the first specimen.

No reproductive apertures were seen in the smaller specimen. In the other they appeared at first to be situated along one margin, but upon closer examination were found to be irregularly alternate, with a tendency for several successive segments to have the reproductive apertures on the same margin. Cirrus short, conical, as seen, 0.17 millimeter in length, 0.05 millimeter in diameter at base, and 0.02 millimeter in diameter at apex.

In all of the foregoing there were numerous minute calcareous bodies, showing under proper optical conditions a concentric structure, and evolving carbon dioxide briskly when treated with acetic acid. These were particularly abundant in the two smaller specimens. They are more abundant in the median and posterior segments, few appearing in the anterior portion of the strobile.

Variety a. (Figs. 67–71.)—Three specimens from a gull captured August 10, 1890, are referred to this species, but on account of certain constant characters of difference they are given a special place.

The specimens measured 15, 17, and 21 millimeters in length respectively; breadth near posterior end 1 millimeter. Head broad, compressed, 0.55 millimeter broad and 0.3 millimeter thick; diameter of neck 0.3 millimeter, in one the diameter immediately behind the head was 0.4 millimeter, and one millimeter back of head 0.32 millimeter. The hooks are exactly twelve in number and measure 0.12 millimeter in length. They agree in shape and size with those of the other specimens. The strobiles are all young and complete—that is, they have not lost any segments. They are rather plump, increasing in breadth uniformly from the neck to near the posterior end. The strobile thus has somewhat the shape of a club, nearly cylindrical in middle portion, but compressed elsewhere. The reproductive apertures are irregularly alternate, with a tendency to be regularly alternate for several successive segments. The apertures are near the anterior edge of the segments at the margins. A series of sections was made of several of the posterior segments, from which it was ascertained that the cirri, which are all retracted, are smooth and agree with those of the others in shape. Calcareous bodies are not so numerous as in the other specimens. The male reproductive organs were well developed, consisting of a voluminous vas deferens, large testicular lobes, containing sperm-

atozoa already developed and developing. Ova had not yet made their appearance. Sinuous marginal aquiferous vessels, as well as very strong fascicles of longitudinal muscles were continuous from segment to segment.

Naturally Krabbe's *Tænia dodecacantha* from *Larus minutus* is suggested by this variety, but that species must be excluded from consideration on account of the character of the spines, which in Krabbe's species are from 0.72 to 0.74 millimeter in length instead of 0.12 millimeter.

Tænia filum Goetze.

(Pl. VIII, Figs. 72–78.)

Diesing, Syst. Helm., p. 530; Sitzb., XIII, p. 607, and XLIX, p. 411.
Dujardin, Hist. des Helm., p. 605. Krabbe, Bitrag til Kunds. om Fugl. Bænd., p. 312, 313, Pl. VIII, Figs. 198–201.

Head subglobose, broader than long; bothria nearly circular; proboscis cylindrical, enlarging at the extremity, with a circle of small abruptly recurved and sharp-pointed hooks, the slender pointed part of the hook parallel with the basal portion and a little longer; neck long and slender; ripe segments subcuneate, posterior marginal edges usually prominent and acute; genital apertures near one of the margins, cirrus slender, tapering, smooth from a swollen spinous basal portion.

Longest specimens observed 52 millimeters in length. Length of hooks 0.025 millimeter.

HABITAT: *Larus californicus*, intestines, Yellowstone Lake; obtained on two different occasions, August 2 and 10, 1890.

The following dimensions are in millimeters. In one specimen, measuring 52 in length, the diameter of the head was 0.2, of the neck 0.1; length of the last segment 0.12, breadth 0.44. In another specimen the diameter of the proboscis at the apex was 0.08, at the base 0.06; diameter of head 0.27, length 0.22; diameter of neck 0.13; length of first segments 0.02, breadth 0.12; diameter of bothrium 0.11.

The diameter of the spinous basal portion of the cirrus was in one instance found to be from 0.012 to 0.015; diameter of filiform terminal portion, near the base, 0.006, tapering to 0.004 at the extremity; length of filiform portion 0.05, of spinous basal portion 0.08.

The segments in some specimens were rather crowded with margins somewhat rounded making convex serrations on the margins. The reproductive apertures were in these cases not immediately at the margins, but at a distance from the nearest margins equal to one-third the entire breadth of the strobile (Fig. 78). In the posterior segments the reproductive apertures are near the margin. One of the specimens with segments thus characterized had the following dimensions: Length 33 millimeters; greatest breadth 0.7 millimeter, at which point the length of segments was 0.1 millimeter; length of posterior segments

0.08 millimeter, breadth 0.4 millimeter. In this specimen the first segments began about three millimeters back of the head.

Some specimens with ripe segments contained ova which were 0.025 to 0.03 millimeter in diameter, and which inclosed typical six-hooked embryos.

Tænia macrocantha sp. nov.

(Pl. VIII, Figs. 79–82.)

Head subglobose, somewhat pyramidal; bothria in lateral pairs and little prominent; proboscis subcylindrical, expanded at apex, contracted at base; hooks in a single circle, large, nine (?) to thirteen; body subcylindrical, segments very short and crowded together anteriorly, lengthening and narrowing posteriorly; strobile, in alcoholic specimens, slightly arcuate with crenate margins; reproductive apertures marginal, all on one margin; cirrus long, filiform, and armed with exceedingly minute spines; largest specimen 15 millimeters long and 1 millimeter broad.

HABITAT: *Œdemia americana*, Yellowstone Lake, Wyoming, August, 1890.

Following are detailed measurements of the largest specimen in the lot, dimensions given in millimeters: Length 15, diameter of head 0.75, diameter of neck 0.60, length of head 0.50, length of proboscis 0.42, diameter of proboscis at base 0.10, diameter of proboscis at apex exclusive of hooks 0.22, diameter of crown of hooks 0.35, length of hooks 0.21, length of first distinct segment 0.025, breadth of first segment 0.65, length of last segment 0.28, breadth of last segment 0.50, greatest diameter of body 1, diameter of cirrus 0.015 to 0.019, length of spines on cirrus not exceding 0.001.

The number of hooks in this specimen was made out to be nine. In order to ascertain the number of hooks accurately, a specimen in which the proboscis was retracted, and which had presumably not lost any of the hooks after it had been put in alcohol, was taken and the set of hooks carefully dissected out. The number in this case was found to be exactly thirteen, and they were 0.22 millimeter in length.

The hooks, when isolated, are seen to be of two sorts, as shown in Fig. 80. In the set of hooks examined, nine of the thirteen were like Fig. 80, *a*, the other four being like those of Fig. 80, *b*. This difference would probably be overlooked except where the hooks are isolated.

The hooks resemble those of *T. megacantha* Rudolphi, as figured by Krabbe (Bitrag til Kunds. om Fugl. Bænd., 80, Pl. IX, Fig. 251). There are, moreover, no characters which are absolutely contradicted in the published descriptions of that species. The descriptions of *T. megacantha* are, however, deficient in detail, and since the hosts are widely different, *T. megacantha* being a parasite of species of *Caprimulgus* and *Nyctibius*, it has appeared to me best to refer my specimens to a new species.

Tænia compressa sp. nov.

(Pl. VIII, Figs. 83–92.)

A large lot of Tæniæ from *Fuligula vallisneria* consists of a variety of forms which, however, upon examination do not afford differences that can be regarded safely as specific. I have therefore referred them to a single species.

This species resembles *T. sinuosa* in the number, size, and shape of the hooks, but differs from it in the absence of the globular spinose sack near the genital orifice, described and figured by Dujardin and others.

Tænia compressa, as represented by the individuals in this lot, may be briefly characterized thus: Head variable, usually broader than long, often pyramidal, compressed laterally, bothria prominent; proboscis ob-conical with a simple crown of rather straight hooks, ten in number and usually about 0.055 millimeter in length; reproductive apertures along one margin, cirrus 0.008 to 0.01 millimeter in diameter, spinose with a smooth conical tip; neck short; first segments usually crowded, much broader than long; median segments in longer strobiles also crowded, very short, ripe segments funnel-form with salient posterior margins.

The specimens in this lot varied from 5 to 27 millimeters in length.

In the preliminary examination of these specimens they were separated into three groups.

The first group contained small club-shaped strobiles from 5 to 10 millimeters in length.

The second group contained longer specimens, 20 to 30 millimeters in length.

The third group was much like the second, but with thicker and broader strobiles.

Two or three fragments were found that appeared to belong to a different species. In them the segments were exceedingly short and crowded and the breadth was about 2 millimeters, considerably greater than that of any of the complete strobiles.

In the first group the neck, *i. e.*, unjointed part of the body, is short, the segments soon become distinct, at first sometimes funnel-form, then much crowded together, becoming funnel-form again towards the posterior end. The segments increase in breadth to near the posterior end, so that the whole strobile becomes somewhat club-shaped. The reproductive apertures are all on one margin of the strobile, each a little in front of the middle of its segment. The elongated bulb of the cirrus (Figs. 89, 91) lies on an elliptical body, which is yellowish and opaque. The bulb is at first nearly transverse to the longitudinal axis, becoming inclined posteriorly at the marginal end in the posterior segments. The cirrus is about 0.01 millimeter in diameter, thickly beset

with minute bristle-like spines, and when fully everted with a short conical tip devoid of spines.

In one specimen measuring 8 millimeters in length the posterior segments contained ova, with embryos, measuring about 0.025 millimeter in diameter.

The proboscis when fully extended is at least as long as the head, expands at the apex, where it bears a circle of ten hooks. These are bent somewhat abruptly near the end, but on the whole are rather straight.

One specimen was observed which agreed with the others in the number and shape of the hooks, but the hooks measured only 0.04 millimeter instead of from 0.05 to 0.055 in the others. The proboscis in this specimen was elongated, cylindrical and 0.4 millimeter in length, or over two and a half times the length of the head. An average specimen 7 millimeters in length had the following dimensions, in millimeters: Diameter of head, 0.18; length of bothrium, 0.15; length of proboscis, 0.16; diameter of proboscis at apex, not including hooks, 0 08; diameter of crown of hooks, 0.12; diameter of proboscis at base, 0.04; diameter of neck, 0.08; length of first distinct segments, 0.025; breadth of first segments, 0.14; length of last segments, 0.37; breadth of last segments, 0.7. In another specimen the diameter of the head was 0.24 millimeter and the diameter of the proboscis at base 0.025 millimeter, while the other dimensions were nearly as in the detailed measurements given.

The specimens of the second group do not present any constant differences, other than size, of sufficient importance to justify their reference to a distinct species or even variety. The head appears to be broader, in some cases at least, in proportion to the length, and the middle segments are much more closely crowded together; the cirrus is also possibly a little more slender. Embryos were observed, 0.04 by 0.03 millimeter in the two principal diameters, with spines measuring 0.01 millimeter in length.

Detailed measurements of a specimen 27 millimeters in length yielded the same results for hooks, proboscis, and segments as were obtained from small specimens of the first group.

Those referred to the third group were characterized by having thick strobiles in which the segments were relatively short and crowded together. In one specimen 15 millimeters in length the last segments were much crowded, measuring 1.1 millimeters in breadth, and 0.13 millimeter in length, otherwise as in the first two groups. The cirrus pouches in some of these larger specimens are inclined at an angle of nearly 45 degrees with the margin; the elliptical body beside the cirrus pouch is not distinct as it is in the smaller specimens.

Several specimens of this species were found in the intestines of *Œdemia americana*. In these the head was compressed laterally, appearing rectangular in outline when viewed from the front. In cases

where the proboscis was completely retracted the bothria were directed forward. The average breadth of the head of three specimens was 0.26 millimeter; length of hooks, 0.055 millimeter; length of the proboscis, 0.14; diameter at base, 0.04; diameter at apex, 0.08; and diameter of crown of hooks, 0.13 millimeter. The specimens were for the most part small, measuring from 8 to 13 millimeters in length. One fragment (Figs. 91, 92) was 20 millimeters in length, its posterior segments 0.4 millimeter long and 1.4 millimeters broad.

In these specimens calcareous bodies were exceedingly numerous. Reproductive organs as in those from *Fuligula vallisneria*.

HABITAT: *Fuligula vallisneria* and *Œdemia americana*, intestine, Yellowstone Lake, Wyoming, August, 1890.

WASHINGTON and JEFFERSON COLLEGE,
Washington, Pa., August 1, 1891.

EXPLANATION OF FIGURES.

[Figs. 64 and 65 from life; all others from alcoholic specimens and drawings by the the author.]

PLATE IV.

Filaria serrata, sp. nov., from *Circus cyaneus* var. *hudsonius*.

Fig. 1. Optical section of head, lateral view, × 350.
Fig. 2. Superficial view of same.
Fig. 3. Diagram of posterior end, ventral view, showing arrangement of anal papillæ of male. The small post-anal pair on the right side were not clearly shown in the specimen.
Fig. 4. Copulatory spines, lateral view, × 225.

Ascaris spiculigera Rudolphi, from *Pelecanus erythrorhynchus* and *P. fuscus*.

Fig. 5. Adult female from stomach of host, × 10. *v*, reproductive aperture.
Fig. 6. Head of male, × 36.
Fig. 7. Another view of same, × 36.
Fig. 8. Posterior end of female, × 36.
Fig. 9. Ova in which segmentation has begun, × 225. *a*, morula; *b*, gastruta stage.
Fig. 10. Diagram of posterior end, ventral view, showing arrangement of anal papillæ in male.
Fig. 11. Lateral view showing copulatory spines, × 36.
Fig. 12. Anterior portion of alimentary canal, × 14. *m*, mouth; *o*, œsophagus; *i*, intestine.

Echinorhynchus rectus, sp. nov., from *Larus* sp.

Fig. 13. Male, slightly compressed, × 6. This and the three following sketched from specimen in oil of cloves.
Fig. 14. Female, slightly compressed, × 6.
Fig. 15. Hooks near base of proboscis, × 225.
Fig. 16. Hooks near apex of proboscis, × 225.
Fig. 17. Bursa of male, showing nucleated cells in walls, × 27.

PLATE V.

Echinorhynchus striatus Goetze, from *Œdemia americana*.

Fig. 18. Optical outline of male, × 45.
Fig. 19. Outline of another from same lot, × 24.
Fig. 20. Caudal spines, × 225.
Fig. 21. Hooks of proboscis, × 225. *a*, apical and *b*, basal of one specimen; *c*, apical and *d*, basal of another.
Fig. 22. Female with embryos, × 15.
Fig. 23. Apex of proboscis of same, × 225.
Fig. 24. Dermal spines of same, × 225.
Fig. 25. Marginal view of dermal spines, × 225.

Holostomum variabile Nitzsch, from *Circus cyaneus* var. *hudsonius*.

Fig. 26. Lateral view, × 21. *a*, anterior aperture, *b*, posterior aperture. The specimen is concave on the dorsal side.
Fig. 27. View of anterior end, × 27. The dorsal side is uppermost in the sketch.
Fig. 28. Longitudinal vertical section, × 42. *a*, anterior aperture; *b*, posterior aperture, into a muscular, suctorial organ; *c*, ejaculatory duct; there does not appear to be a true cirrus; *p*, papilla at the summit of which the ejaculatory duct and the uterus lie as a common duct. The papilla and muscular sucker probably constitute a copulatory organ. *cp*, seminal vesicle, corresponding to a bursa penis; *vsa.* and *vsp.* anterior and posterior seminal receptacle; *t*, testes; *v*, aperture of vagina; *o*, germ gland or ovary; *gd*, germ duct; *cd*, common duct, which passes around the anterior testis, and between the two testes receives the vitelline duct *yd'*; *sg*, shell gland; *u*, origin of uterus; *u'*, uterus near posterior end; *yd*, one of the two longitudinal vitelline ducts; *vg*, vitelline or yolk gland; *ov*, ova in anterior uterine spaces; *o'*, ova in posterior portion of uterus; *s*, ventral sucker, see Fig. 29, *s*; *x*, glandular organ, the *kügliger korper* of Von Linstow.

Sketch from a single section, but the ducts represented by *v*, *cd*, and *yd'* somewhat diagrammatic. Transverse sections of the convoluted common germ duct are shown between the testes.

Fig. 29. Longitudinal vertical section of the anterior division of the body, several sections removed from that shown in Fig. 28, × 52. *m*, mouth surrounded by a muscular suctorial organ and communicating by a short passage with the muscular pharnyx *ph*; *i*, intestine which is bifurcate in front of the ventral sucker *s*, a lateral branch passing on either side of that organ; *dm*, dorsal longitudinal muscles; *lm*, lateral longitudinal muscles; *vm*, ventral longitudinal muscles; *vg*, vitelline glands; *y*, section of invaginated fold, apparently an organ of absorption; *a*, anterior aperture.

PLATE VI.

Holostomum variabile Nitzsch.

Fig. 30. Cells of germ gland or ovary, × 360.
Fig. 31. Section of segmenting ovum, × 375.
Fig. 32. Transverse section of vitelline duct near its union with the common germ duct, showing the peculiar arrangement of yolk globules, × 360.

Distomum (?) *verrucosum*, sp. nov., from *Larus californicus*.

Fig. 33. Specimen coiled in a spiral, × 15.
Fig. 34. Anterior end of same specimen, × 24.
Fig. 35. Fragment, × 15. The tubercles are somewhat more enlarged.

Distomum flexum, sp. nov., from *Œdemia americana*.

Fig. 36. Lateral view, × 15.
Fig. 37. Ventral view of head of same, × 38.
Fig. 38. Dorsal view of body, ventral of head, compressed, × 30.
Fig. 38*a*. Oral hooks, × 225.
Fig. 39. Segmenting ovum, × 225.
Fig. 40. Another showing more advanced stage of segmentation, × 225.
Fig. 41. Oral hooks, dorsal view, × 180.
Fig. 42. Cirrus and bursa, × 60.
Fig. 43. Pharnyx, × 180.
Fig. 44. Cervical spines, × 225.

Dibothrium cordiceps Leidy., from *Larus californicus*.

Fig. 45. Lateral view of head of immature specimen, × 27.

Dibothrium exile, sp. nov., from *Larus californicus*.

Fig. 46. Marginal view of head, × 30.
Fig. 47. Anterior segments, lateral view, × 14.
Fig. 48. Posterior segments, lateral view, × 14.

Epision plicatus gen. et sp. nov., from *Œdemia americana*.

Fig. 49. Lateral view of head and anterior part of body of smallest specimen, × 12.
Fig. 50. Lateral view of head of largest specimen, × 15.
Fig. 51. Portion of head near apex, × 54.
Fig. 52. Lateral view of margin of head, × 225.
Fig. 53. Posterior end of largest specimen, lateral view, × 12.

PLATE VII.

Fragments of Tœnia from *Colymbus* sp. and *Larus* sp., *T. capitella* Rud. (?) *Colymbus* sp.

Fig. 54. Posterior segments, lateral view, × 12.
Fig. 55. Marginal view of same, × 12.

T. fusus Krabbe (?) from *Larus* sp.

Fig. 56. Posterior segments, lateral view, × 12

T. larina Krabbe ? from *Larus* sp.

Fig. 57. Fragments, × 12: *a*, anterior; *b*, postmedian, and *c*, posterior segments.
Fig. 58. Ovum of same, × 345.

Tænia porosa Rudolphi, from *Larus californicus*.

Fig. 59. Head with proboscis extended, lateral view, × 56.
Fig. 60. Anterior segments of same, × 12.
Fig. 61. Antero-median segments, × 12. The genital apertures are not quite uniformly alternate.
Fig. 62. Posterior segments, × 12.
Fig. 63. Hooks, × 360.
Fig. 64. Ovum with embryo, from life, × 180: *a*, external pellicle; *b*, finely granular food-stuff with a few globular masses of varying size; *d*, finely granular and homogeneous material assuming a flowing appearance at *e*; *f*, granulo-nuclear patch; *g*, vacuolar granular area; *h*, granular area with large vacuolar spaces; *c*, embryo with four of the six hooks showing.
Fig. 65. External pellicle of ovum, highly magnified, from life.
Fig. 66. Hooks of a single embryo, in position, × 345.

Var. *α*.

Fig. 67. Head with rostellum retracted, × 60.
Fig. 68. Rostellum of same, × 225.
Fig. 69. Hooks of same, × 360.
Fig. 70. Anterior segments, × 22.
Fig. 71. Posterior segments, × 12.

PLATE VIII.

Tænia filum Goetze, from *Larus californicus*.

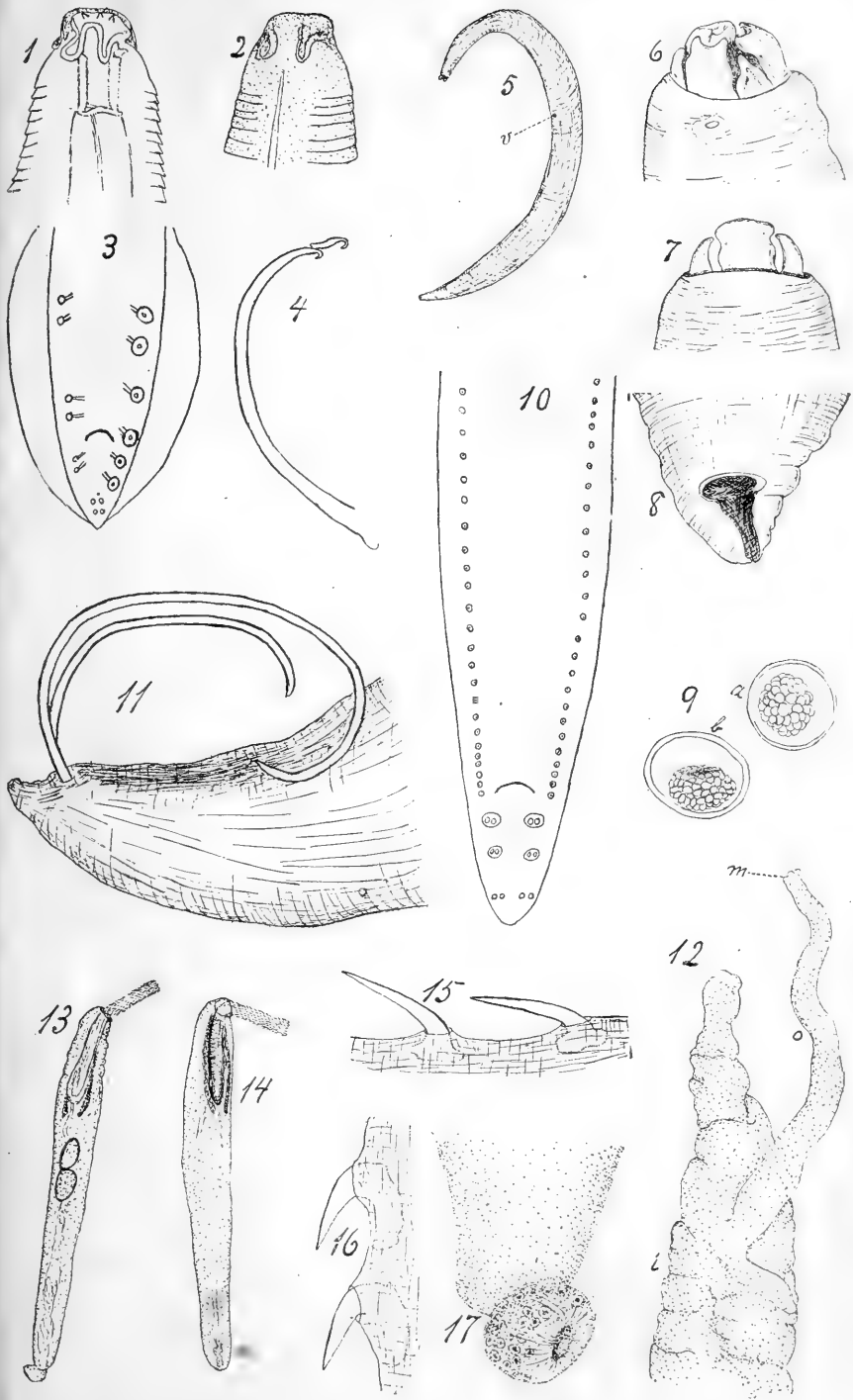
Fig. 72. Head with rostellum retracted, × 225.
Fig. 73. Head and neck, proboscis exserted, × 52.
Fig. 74. Proboscis and hooks of same, × 360.
Fig. 75. Hooks of No. 72, × 345.
Fig. 76. Posterior segments of No. 73, × 52.
Fig. 77. Cirrus of same, × 345.
Fig. 78. Postero-median segments of No. 72, × 56.

Tænia macrocantha, sp. nov., from *Œdemia americanus*.

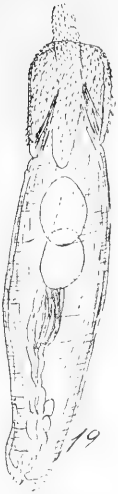
Fig. 79. Head with proboscis exserted, × 30.
Fig. 80. Hooks of same, × 360.
Fig. 81. Posterior segments of same, × 16.
Fig 82. Last two segments of same, × 45.

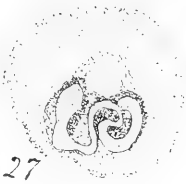
Tænia compressa, sp. nov., from *Fuligula vallisneria* and *Œdemia americana*.

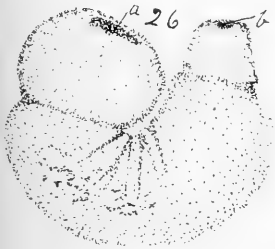
Fig. 83. Head and neck of specimen from *Fuligula*, × 54.
Fig. 84. Proboscis and rostellum of another from same host, × 225.
Fig. 85. Hooks of same, × 345.
Fig. 86. Hooks from another specimen, same host, × 345.
Fig. 87. Postero-median segments, same host, × 27.
Fig. 88. Posterior segments, same, × 27.
Fig. 89. Posterior segments of another, different individual host, × 30.
Fig. 90. Cirrus of No. 88, × 360.
Fig. 91. Postero-median segments, from *Œdemia*, × 15.
Fig. 92. Hooks of same, × 360.

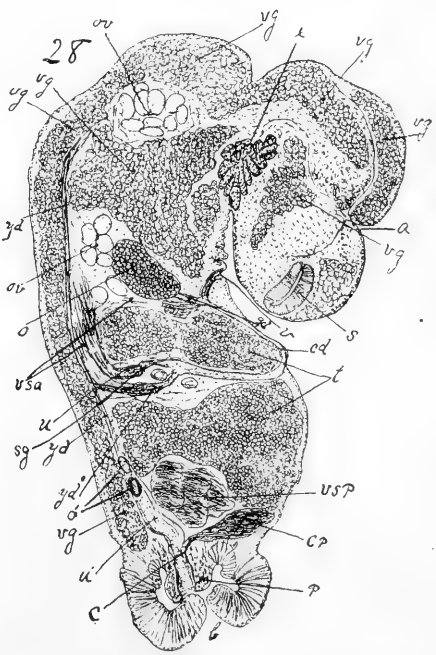


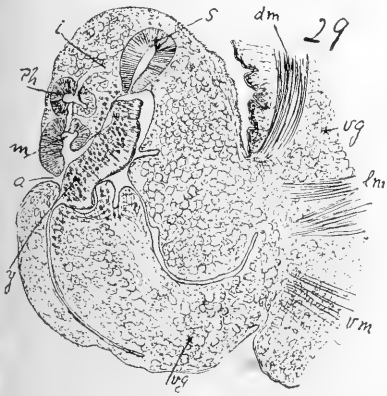
AVIAN ENTOZOA.











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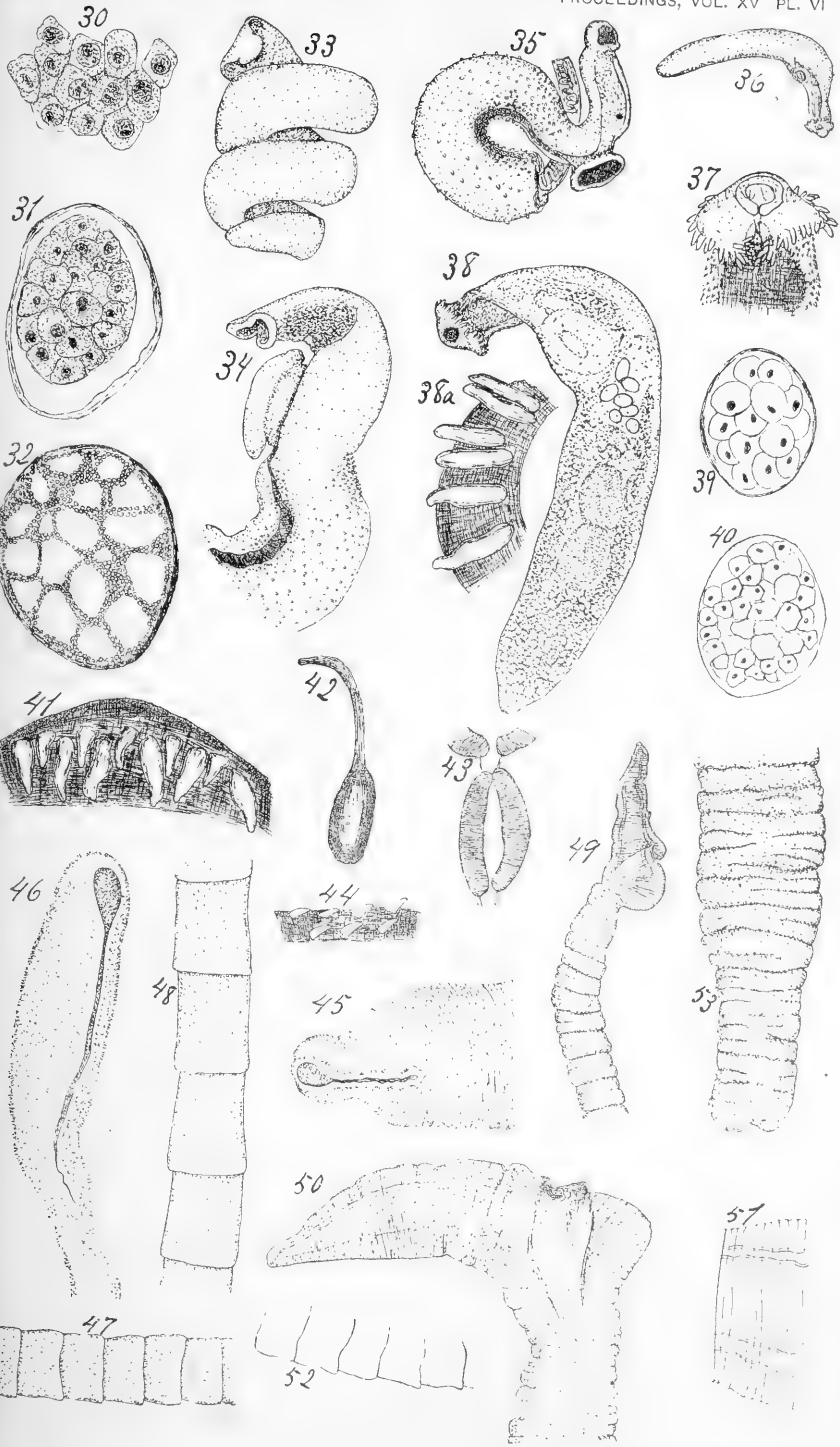

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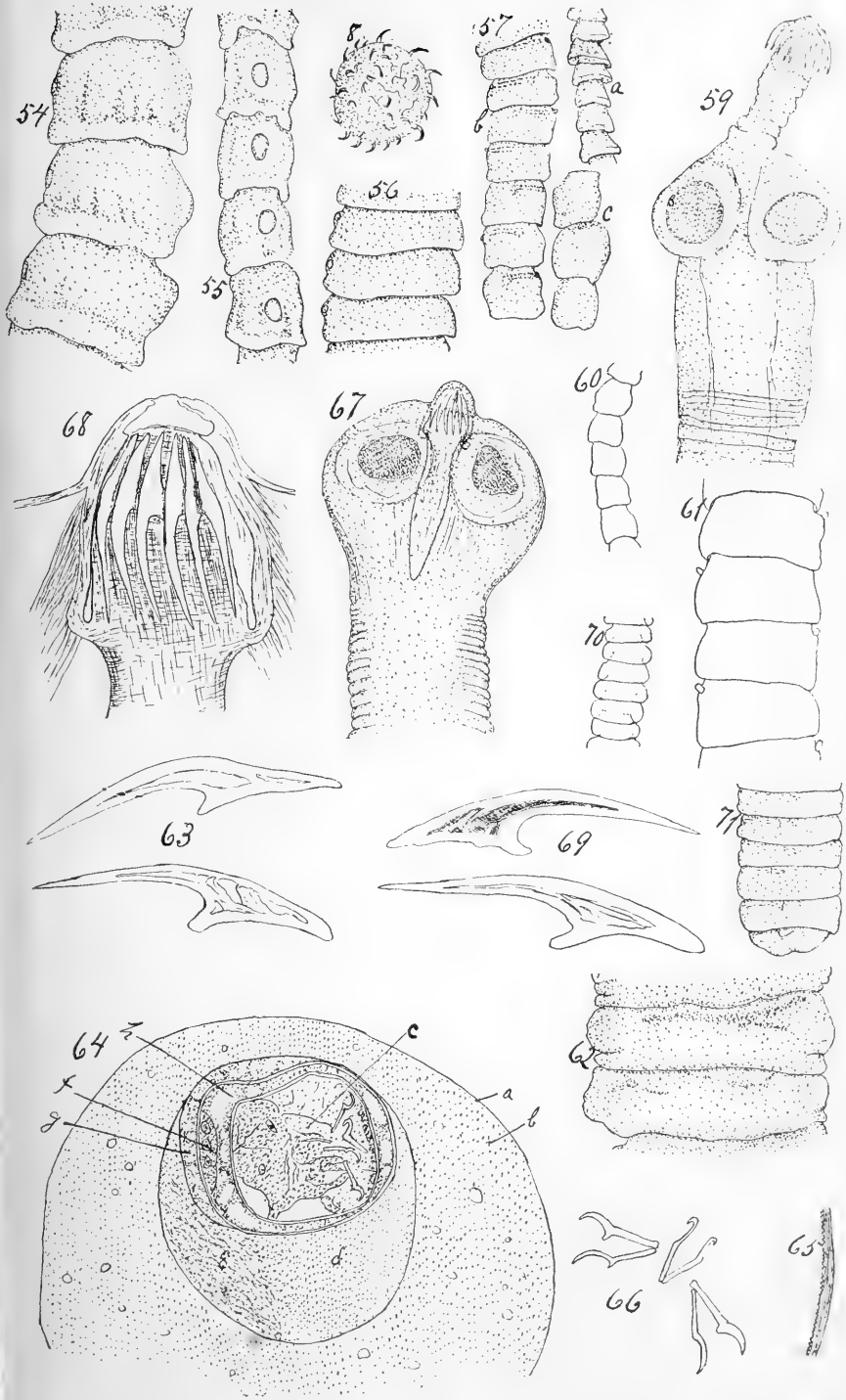
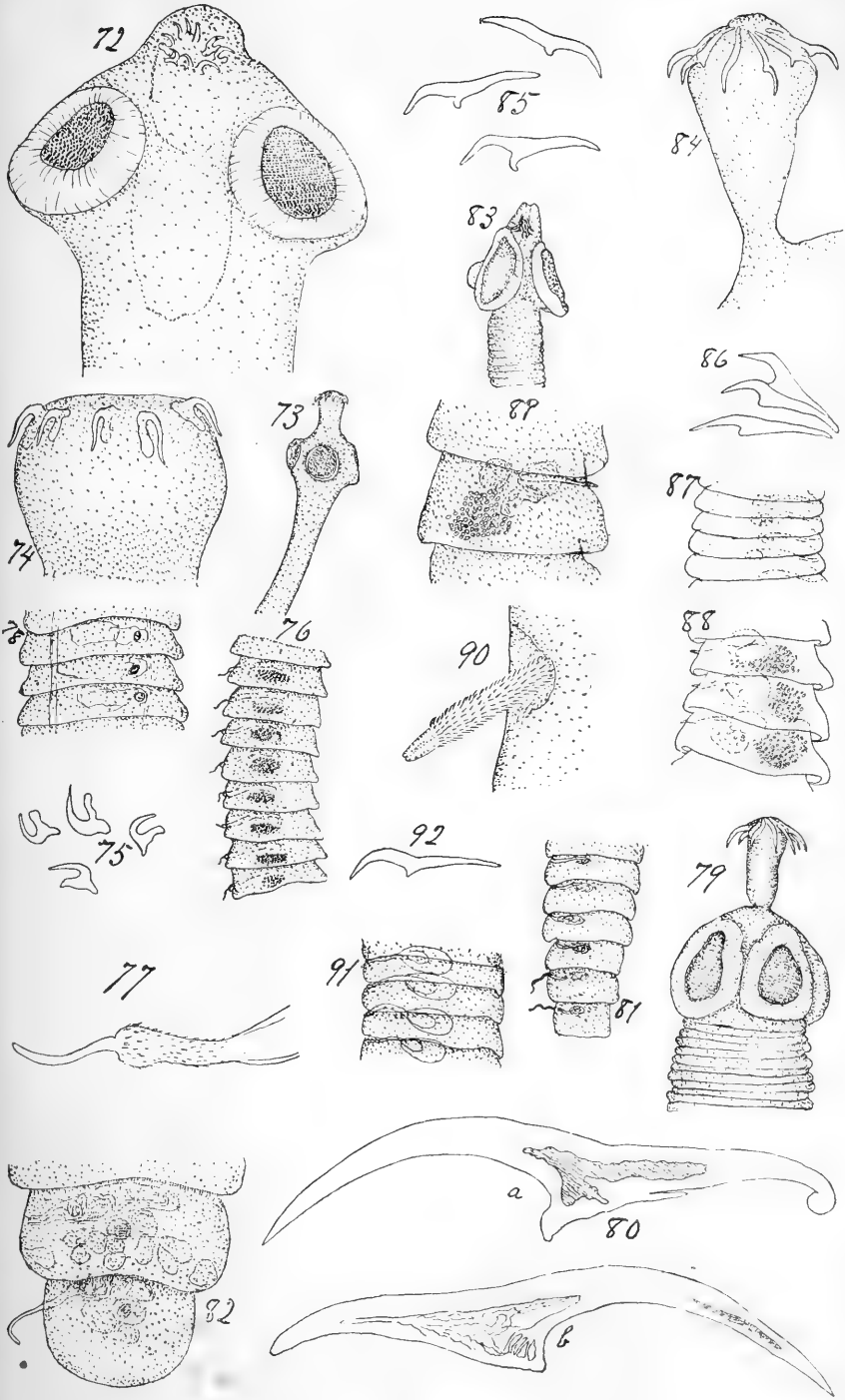


AVIAN ENTOZOA.



AVIAN ENTOZOA.

PRELIMINARY DESCRIPTION OF A NEW GENUS AND SPECIES OF BLIND CAVE SALAMANDER FROM NORTH AMERICA.

BY

LEONHARD STEJNEGER.

Curator of the Department of Reptiles and Batrachians.

(With plate IX.)

The discovery of a blind cave salamander on our continent is one of the most important and interesting herpetological events of recent years. A new genus and species of salamander may not be such a startling novelty even at this late date, but the interest is considerably heightened when we have to do with the first and only blind form among the true salamanders.

The discovery is primarily due to Mr. F. A. Sampson who, in July last year, found the adult animal as well as a larva in the Rock House Cave, Missouri, and kindly forwarded both to our museum. I have also to thank Mr. George E. Harris, who afterwards went to great trouble in order to procure me additional specimens. Unfortunately, he has only succeeded so far in obtaining larvæ, but we hope to be able during the present year to secure more adults.

A more detailed anatomical description of this interesting animal will have to be postponed until then, as I have not felt justified in mutilating the type specimen beyond what was necessary in order to ascertain the character of the vertebræ. The present preliminary description is, therefore, only prepared in order to call attention to the discovery and to supply the diagnosis by which the animal may be identified.

TYPHLOTRITON, gen. nov.

(*τῦφλός*, blind; *τρίτων*, *ὁ*, salamander.)

Of the family *Desmognathidæ*: Vertebræ opistocœlous; parasphenoid teeth; vomerine teeth. Eyes concealed under the continuous skin of the head; tongue attached in front and along median line, free laterally and posteriorly; maxillar and mandibular teeth small and numerous; vomerine teeth in two strongly curved series; parasphenoid patches separate; nostrils very small; toes five.

Type: *Typhlotriton spelæus* STEJN.

Typhlotriton spelæus, sp. nov.

DIAGNOSIS: Sixteen costal grooves; tail slightly compressed, not finned; toes nearly half webbed; vomerine teeth in two *v*-shaped series with the curvatures directed forward; gular fold strong, very concave anteriorly; color uniform pale.

HABITAT: Rock House Cave, Missouri.

Type: U. S. National Museum, No. 17903, July 24, 1891, F. A. Sampson coll.

Description of type specimen.—(♀ ad).—Head wide, much wider than neck, very depressed and flat on top, with no canthus rostralis; snout rather swollen, truncate; nostrils very small; eyes small, only slightly raised, and covered by the continuous skin of the head with only a shallow groove to indicate the opening between the lids, the underlying eyes only visible as two ill-defined dusky spots; body somewhat depressed, measuring thrice and a third the distance from snout to gular fold; limbs short, about five costal interspaces apart when laid against the body; fingers rather short, especially the first, nearly free; length, beginning with the shortest, 1–4–2–3; number of phalanges 1–2–3–2; toes rather short, first almost rudimentary, nearly half-webbed; length, beginning with the shortest, 1–2–5–4–3, second and fifth, and fourth and third being nearly equal; number of phalanges 1–2–3–3–2; tail considerably shorter than head and body, subcylindrical at base and somewhat squarish, more compressed toward the tip, rounded above, faintly keeled below; skin minutely granulate; gular fold strong, very concave anteriorly and uniting on the sides of neck with a horizontal groove running from eye backwards; sixteen costal grooves, or eighteen, if counting the axillar and groin grooves, crossed on the sides by a strong horizontal groove between axilla and groin.

Maxillar and mandibular teeth small, numerous, normal; vomerine teeth not extending outside of the choanæ, forming two *v*-shaped, strongly curved series with the points directed forward, the external branches straight, the internal ones curved inward and well separated; parasphenoid patches, long, rather narrow, well separated, their distance being nearly equal to their width, and well separated from the vomerines; teeth small, in numerous rows.

Tongue rather large, attached anteriorly and along the median line for a trifle more than the anterior half, extensively free laterally and posteriorly.

Color (in alcohol) uniform creamy yellow; in life, "pale."

Dimensions.

	Millimeters.
Total length	93.0
From snout to gular fold	12.0
From snout to anus	52.0
Width of head	8.5
Fore limb	11.0
Hind limb	13.0
Tail	41.0

Mr. Sampson informs me that the animal was caught on the rocky walls of the cave about 600 feet from the entrance. The Rock House Cave is "an erosion of rocks of the Chouteau and Burlington formations, in places not more than 2 feet wide, and in others several times that, and extending into the hill about a quarter of a mile."

Although many of our salamanders are known to inhabit caves, this seems to be the only one, so far discovered, which, like some of the other animals exclusively living in caves, has become blind, or nearly so.

I am at present unable to indicate the forms with functional eyes to which the present genus is most nearly allied, or from which it may have descended. The unique character of the vomerine teeth at once removes it from all the species with which I am acquainted, and this, combined with several other characters, gives this genus quite an isolated position. But a further discussion of this may safely be postponed until the arrival of additional material shall enable us to study the anatomical structure of this remarkable animal.

DESCRIPTIONS OF TWO NEW FORMS OF BASILEUTERUS RUFIFRONS, FROM MEXICO.

BY
ROBERT RIDGWAY.

Curator of the Department of Birds.

1. Basileuterus rufifrons jouyi, subsp. nov.

SUBSP. CHAR.: Differing from true *B. rufifrons* in grayish-brown instead of olive-green color of the upper parts, only the edges of the remiges and rectrices inclining to olive-green; whiter under parts, the median portion of breast and belly being quite white, the yellow sharply restricted to throat and chest, the sides of the breast nearly pure ash-gray; bill smaller, but other dimensions not appreciably different.

HABITAT.—Northeastern Mexico (type, No. 124912, U. S. National Museum, ♂ ad., Hacienda Angostura, San Luis Potosi, December 8, 1891; P. L. Jouy.

An adult female (No. 124913), collected at the same time and place, is essentially identical with the male.

2. Basileuterus rufifrons dugesi, subsp. nov.

SUBSP. CHAR.: Similar to *B. rufifrons jouyi*, but browner above, with pileum and ear-coverts decidedly lighter chestnut or rufous.

HABITAT.—Western Mexico (type, No. 105263, U. S. National Museum, ♂ ad., Guanajuato, Mexico; Prof. A. Dugès).

The six adult examples of true *B. rufifrons* with which the above-mentioned supposedly new forms have been compared, are all from southeastern Mexico (Mirador and Xalapa, State of Vera Cruz, and Guichicovi, State of Oaxaca). They all agree in the distinctly olive-green color of the upper parts (only the hind neck having a slight grayish tinge), and in having the median under parts more or less tinged with yellow on a pale buff or buffy white ground, the sides of the breast being olive or grayish brown instead of nearly clear ash-gray.

An example from the Sierra Madre near Mazatlan (No. 34018, December, 1861, A. Grayson), agrees closely in coloration with the type of *B. rufifrons dugesi*, but, owing probably to fresh plumage, is a little browner above.

DESCRIPTION OF A NEW SPECIES OF STAR-GAZER (CATHETOSTOMA ALBIGUTTA), FROM THE GULF OF MEXICO,

BY

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The steamer *Albatross* has taken some specimens of a species of *Cathetostoma*, apparently the first of the genus known from the Atlantic, at station 2403, where two specimens were obtained. This station is in north latitude 28° 42′ 30″, west longitude 85° 29′ 00″; depth 88 fathoms. At station 2404 two specimens were also taken; north latitude 28° 44′, west longitude 85° 16′; depth 60 fathoms. These two stations are in the Gulf of Mexico. At station 2410, in north latitude 26° 47′ 30″, west longitude 83° 25′ 15″, from 28 fathoms, one specimen was trawled. At station 2411, north latitude 26° 33′ 30″, west longitude 83° 15′ 30″, in 27 fathoms, a young example, 40 millimeters long, was taken. The last two stations are between Tampa Bay and Dry Tortugas, Fla. The largest examples are those taken at station 2403. These specimens are referred to in the description which follows: They are nearly equal in size, the largest one being 160 millimeters long. The length to the base of the caudal is 123 millimeters. The greatest height of the body (35 millimeters) is contained three and a half times in the standard length, and its greatest width is about the same. The length of the head (44 millimeters), not including the preopercular spine, is a little more than one-third of the standard length. The greatest width of the head (42 millimeters) is one-third of the standard length. The width of the interorbital space (11 millimeters) is one-fourth of the length of the head. It contains a deep groove, the length of which is slightly greater than its width and nearly equals the length of the eye. The mouth is nearly vertical when closed. The intermaxillary is slightly protractile. The length of its tooth-bearing surface (13 millimeters) is two-sevenths the length of the head. The maxilla is very broadly expanded behind. Its greatest width (8 millimeters) is about equal to one-third of its length (21 millimeters). The maxilla extends almost to the vertical from the middle of the eye, and the end of the mandible is not much farther back. The length of the mandible (26 millimeters) is contained four and two-thirds times in the standard length. The mandible has two blunt prominences at its

posterior end. The exposed portion of the maxilla is traversed by radiating striæ. The lower limb of the preoperculum has three stout spines along its lower border. The length of the humeral spine (15 millimeters) is one-third the length of the head. The humerus is very strongly rugose on its upper border. Three short spines on the anterior edge of the preorbital. Teeth in villiform bands in the intermaxillary and mandible and on the vomer. Palatines in a very short band. A cavity between the head of the vomer and the processes of the intermaxillary ending in a semicircular canal behind, which is separated from the anterior cavity by a flap of skin. Gill openings very wide and only narrowly attached to the isthmus, leaving a free posterior border. Pseudobranchiæ present, small. A small narrow slit behind the last gill; its length about two-thirds that of the eye. Gill rakers tubercular, nine on the anterior arch. A pair of short but stout spines in front of the ventrals. The origin of the dorsal is a little nearer to the root of the caudal than to the tip of the snout; it is midway between the base of the caudal and the middle of the eye. The length of the dorsal base (43 millimeters) is about one-third of the standard length. The third ray is the longest, its length (20 millimeters) being nearly one-half the length of the base of the fin. The last ray is about as long as the eye, and the first is scarcely longer than this. The anal origin is directly under that of the dorsal, and the base of the fin is slightly longer than that of the dorsal. The seventh, eighth, and ninth anal rays are about the longest, their length (17 millimeters) equalling about one-half that of the middle caudal rays. The first ray is not much more than one-half as long as the longest and the rays gradually increase in size to the ninth. The length of the pectoral (35 millimeters) is contained three and one-half times in the standard length. The length of the lowermost ray is less than one-fourth the length of the head. Only the first ray is simple; the rest are divided. The ventral origin is under the eye. The longest ray of the ventral (24 millimeters) is slightly shorter than the mandible. Caudal slightly rounded when expanded; the middle rays as long as the head without the snout. The lateral line begins near the root of the humeral spine, curves upward slightly and runs along the back to the end of the dorsal, then curves downward to near the middle of the caudal base. Skin naked. *Colors:* Upper parts light brown, the upper surface of the head minutely dotted with white; the back with numerous roundish spots and oblong blotches of whitish; lower parts pale. The dorsal with two or three dark blotches near the margin, in some cases not much larger than the eye, in others fully twice as long. Caudal with nine black blotches, those on the outer rays largest, differing in size in different specimens. These blotches are distributed over the greater portion of the fin. Anal pale, with the exception of a brownish blotch on the membrane of the last three rays. Pectoral with a brownish submarginal band on its outer half; this band sometimes broken up on the membrane. Ventrals pale.

THE FISHES OF SAN DIEGO, CALIFORNIA.

BY

CARL H. EIGENMANN,

Professor of Zoology, Indiana University.

(With Plates X–XVIII).

The present paper contains an account of the observations made by me on the fishes of San Diego and vicinity from December 11, 1888, to March 4, 1890.

Especial attention was paid to the spawning habits and seasons, the embryology, and *migration* of the fishes of southern California. A diary was kept of the occurrence of each species throughout the year 1889 and part of 1890.

My knowledge of the occurrence of each species is largely based on observations of the fish brought into the markets, which I visited twice or thrice daily, and of those caught with hook and line by the numerous habitual fishermen found on each of the wharves, and of those caught by the seiners whom I accompanied on several occasions. During the early part of 1888 each individual fisherman sold his catch as best he could and the data for this part of the year are not as full as for the latter part of 1888, when practically the whole catch was brought to two markets, where I could see the fish as they were unloaded. The knowledge of the ocean fishes is largely derived from frequent visits to ocean tide-pools, from the fish brought to the markets, and from a two-weeks' stay on the Cortes Banks. As a matter of course, hundreds of specimens of most species have been observed to every one preserved, and the present paper is to be looked upon as a contribution to the economic history of the fishes, rather than to the anatomy of the various species.

With two exceptions the types of the new species discovered and otherwise interesting specimens have been deposited in the U. S. National Museum. A nearly complete series of types has been placed in the British Museum and minor series in the Museum of Comparative Zoology and the California Academy of Sciences.

The fishing grounds about San Diego are: (1) San Diego Bay; (2) False Bay; (3) the shoal water (down to 100 fathoms) skirting the coast; (4) the Coronado Islands; and (5) the Cortes Banks. There are shallows off Coronado Beach which have not been examined.

The faunæ of Nos. 1 and 2 are essentially alike and quite different from those of 3 to 5. The former are characterized by the presence of *Sciænidæ*, *Embiotocidæ*, *Atherinidæ;* the latter, by the *Scorpænidæ*, *Sphyrænidæ*, *Scombridæ*, etc.

San Diego Bay is about 18 miles long by 1 to several miles wide. Its shores are sandy or muddy. There being no streams emptying into it it contains pure sea water. False Bay is much smaller and shallower and in winter receives the water of the San Diego River.

Only two methods of taking fish are employed in these two bays, viz, by seine and by gill net. The latter is only occasionally used, but so effective is the seining that unless it is stopped (all of it is illegal) the fisheries of the bay will soon be worth nothing.

Only two methods of fishing are employed off shore, trolling and hand-line fishing. The trawl and gill nets are not used. The trolling is employed to catch Spanish mackerel and barracuda, the hand line to catch white-fish and rock-cod. The gill net and troll could probably be successfully used in the shoal water off Coronada Beach.

The young of many of the species the adult of which are always found outside often enter the bay. For instance, tinkers abound in the bay, while adult mackerel are never found, except outside. Young barracuda are sometimes found in abundance, half-grown Spanish mackerel enter the bay, and the young *Paralebrax clathratus* are common while the adult is usually taken outside.

Those specimens of outside species living in deeper water are always larger than those coming from shallower water.

On the Cortes Banks the young of the species of the genus *Sebastodes* abound on the elevated ridge, while the adult are always found in deeper water.

Those representatives of species abundant farther north are frequently much larger than the average size of the northern individuals. For instance, *Sebastodes proriger* reaches on an average 10 inches near San Francisco, while one found here measured about 24 inches. This may be partly explained by the fact that these specimens usually come from deep water.

The color of the same species of bottom fishes inhabiting the bay and the outside varies greatly, and even the same species at different depths or on different bottom, show remarkable changes.

Sebastodes vexillaris varies from flesh color to the brightest scarlet and olive color. A local fisherman explains the color of this fish by the fact that fishes in shallow water are likely to be blacker, those in deep water lighter, and those on hard, rocky bottom of moderate depth bright red. *Scorpæna guttata* deserves special mention. It is found both in the bay and outside, on the rock-cod banks. Those found in the bay are dull colored, chiefly brown, variously mottled, while those from the outside have the brown replaced by the brightest scarlet. The color is so strikingly different that I have repeatedly thought the two fishes to be distinct.

Four lists of the fishes of San Diego have been published. Jordan and Gilbert in their first list, referred to as J. and G., '80 (Proc. U. S. Nat. Mus., 1880, 23) gave notes on fifty-seven species collected by them. Rosa Smith, in her first list, referred to as R. Smith, '80 (Nov., 1880), enumerated eighty-two species. In their second list Jordan and Gilbert, '80a (*l. c.* 452) enumerated eighty three. The fourth, or Rosa Smith's second list, '85 (West American Scientist, June, July, and August, 1885), contained the names of one hundred and nine species.

In the Proceedings of the U. S. National Museum for 1881, Jordan and Gilbert give notes on the fishes of the Pacific Coast in general. This paper is quoted as J. and G., '81; their synopsis of the fishes of North America as J. and G., '82. Our three papers, Notes from the San Diego Biological Laboratory, I, II, and III, are referred to as '89, '89a, and '90. The other papers are quoted in full.

The present list enumerates one hundred and seventy species and varieties. Of these I have observed all but the following during my stay at San Diego. (1) *Carcharinus lamiella;* (2) *Manta birostris;* (3) *Hippocampus ingens;* (4) *Siphostoma punctipinne;* (5) *S. Californiense;* (6) *Gasterosteus microcephalus;* (7) *Caranx caballus;* (8) *Chætodipterus faber;* (9) *Neoclinus blanchardi;* (10) *Sphæroides politus*; (11) *Diodon hystrix.* I am not certain whether numbers 3, 7, 8, 10, and 11 of the foregoing should not be discarded. They have not been taken here within the last ten years. The others have been taken either by Rosa Smith prior to 1887 or they have been authoritatively recorded from here by others. The species (60) added to the San Diego fauna during the period covered by this paper have already been enumerated: in the Proceedings of the U. S. National Museum, 1888, 463: the West American Scientist for October and November, 1889: the Proceedings of the California Academy of Sciences, second series., vol. III, p. 1, 1890, and in the American Naturalist February, June, and December, 1891, and January '92. Of the sixty species added over twenty were new to science, most of the others being forms already well known from the northern part of California. Comparatively few southern species have been added.

I have found surprisingly few species of pelagic fish eggs. This is probably due to the limited means of collecting them and to the fact that at least 30 per cent of the teleosts inhabiting the region are viviparous.

The following synoptical key will perhaps assist future investigators to identify some of the species of fish eggs found at San Diego.

A key to the species of ova observed.

* The egg is large and has a leathery covering; the young leaves it in an advanced stage possessing most of the characters of the adult..... SELACHIANS.†

A. Egg case flat, purse shaped ..... SCYLLIORHINUS.

AA. Egg case spirally twisted, subconical..... HETERODONTUS.

† Only two of the many genera of Selachians found here are oviparous.

* * The egg is small, with a zona radiata for covering; the young leaves it as a larva.

a. The egg is hatched in the mother.

b. All the intraovarian food is supplied by the large yolk, which always contains one or more oil-globules. Young leaving mother in larval stages....SEBASTODES.

bb. Intraovarian food mostly supplied by secretions of the ovary. Eggs small, owing to the nonformation of food deutoplasm. Development characterized by the hypertrophy of the hind gut and later by the hypertrophy of the fins and their capillaries. Young leaving mother in a mature stage.....EMBIOTOCIDÆ.

aa. The egg is hatched in water.

c. Nonpelagic eggs.

d. Eggs very large, 5 millimeters or more in diameter.....PORICHTHYS.‡

dd. Eggs much less than 5 millimeters in diameter.

e. Zona radiata without filaments or projections.

f. Eggs cohesive (pelagic?); several oil globules..OLIGOCOTTUS ANALIS. (LEPTOCOTTUS.?)

ff. Eggs adhesive, protoplasm yellow, no oil globules.

CLUPEA MIRABILIS.

ee. Zona radiata with filaments scattered over its whole surface.

g. Filaments numerous, placed directly on the zona.

FUNDULUS PARVIPINNIS.

gg. Filaments few, very long, tapering, set in sheaths of the zona. (GOBIESOCIDÆ.)

h. Eggs large 2.4 millimeters in diameter, amber colored.

TYLOSURUS EXILIS. §

ggg. Filaments few, their disk-like basal expansions hollow, fitting into projections of the zona. (ATHERINIDÆ.)

i. About ten filaments; several oil-globules during the early stages.....ATHERINOPSIS.

eee. Zona radiata with filaments or other processes on restricted regions.

j. Mushroom-shaped processes near micropyle.

GASTEROSTEUS.

jj. A meshwork of filaments attached in a circle about the micropyle. The zona much elongate, club-shaped, attached to lower surface of rocks.

ZIPHLOGOBIUS CALIFORNIENSIS.

jjj. Numerous fine filaments forming a cushion over nearly half the zona; yolk salmon pink; white and deep purple oil-globules.

ISESTHES.

k. Spawning in March in rocky tide pools of the ocean beach.

I. GILBERTI.

kk. Spawning in May in the bay. I. GENTILIS.

‡ We have not seen the developing eggs of this species. They are probably fastened to objects in some way or other. The male is provided with a large (nidamental?) gland.

§ The eggs of the other members of this family occurring here have not been examined.

cc. Pelagic eggs.

l. A large number of ova embedded in a transparent matrix; no oil globule. FIERASFER.

ll. Ova separate.

m. No oil globule.

n. Yolk in large segments, clear.

o. Round ova.....STOLEPHORUS COMPRESSUS.

oo. Oval ova..STOLEPHORUS DELICATISSIMUS AND RINGENS.

mm. One or more oil globules.

p. Embryo developing black pigment in the ovum.

q. Oil globule at the time of hatching situated at the anterior end of the yolk. PARALABRAX NEBULIFER.

pp. Embryo developing black and brownish pigment in the ovum.

r. Oil globule at the time of hatching situated at the anterior end of the yolk.

s. Yellowish pigment at the time of hatching in definite regions, viz:—at the mouth, at the middle of the body, over the anus and at some distance behind the anus..PARALABRAX MACULOFASCIATUS.

rr. Oil globule at the time of hatching at or near the posterior end of the yolk.

t. Chromatophores appearing when gastrula covers about one-third of the yolk, proliferated from the embryonic shield and the entire embryonic ring; fewer chromatophores on the tail at the time of hatching..SCIAENA SATURNA (and other species of Sciaenidae?)

tt. Chromatophores appearing when the gastrula covers about two-thirds of the yolk, proliferated from the embryo only; more chromatophores on tail at the time of hatching..HYPSOPSETTA GUTTULATA.

aaa. The eggs are hatched in a brood-pouch along the ventral surface of the male.....SYNGNATHIDAE.

UNIDENTIFIED EGGS.

Species No. 1. Plate x, figs. 6-9.

One egg of this species was dredged August 14, at 9:15 a. m., in the stage represented by fig. 6, Pl. I. The egg is transparent, the globule amber-colored. The egg measures 0.80 millimeter, the oil globule 0.12 millimeter. The pigment cells were minute and the difference between yellow and black not well marked.

Four hours later the tail is just beginning to develop. The oil globule is very sparingly pigmented; the yolk sack in the neighborhood of the globule is covered with many yellow and one or two black cells. The color cells on the embryo are very small and numerous, the black ones as usual are on the dorsal, the yellow ones on the ventral surface of the embryo.

Another egg was found August 28, and is represented in fig. 8. The tail is much developed and the pigment more conspicuous.

On hatching the yolk sack is 0.80 millimeter long, and the total length of the larva (fig. 9) is 1.4 millimeters. The globule is well pigmented and there are a number of chromatophores on the yolk sack below, in front of the globule. The chromatophores are pretty evenly distributed over the fish.

Species No. 2. **Pleuronichthys cœnosus ?** Plate x, figs. 10–13.

A single egg of this species was found April 26, at 12:30 p. m. The marginal infolding of the gastrula was well begun.

The egg was smaller than that of *Hypsopsetta* and was supposed to be that of *Pleuronichthys cœnosus.* It measured 0.71 millimeter in diameter and the single small globule was scarcely more than 0.08 millimeter in diameter.

The blastopore closed somewhat over seven hours after the stage represented in fig. 10. Nineteen hours after fig. 10 pigment has been formed, the embryo is comparatively narrow. In place of Kupffer's vesicle there was a double vesicle, one behind the other, as represented in figs. 11 and 12. This was in all probability a pathological specimen.

In the figures only black-pigment cells are drawn; in later stages numerous greenish-yellow cells become prominent wherever there are black ones. They are especially abundant about the head and on the body near the end of the yolk sack.

SUMMARY OF THE DAILY OBSERVATIONS.

The following lists are an abridgment of the detailed records kept for the species.

The following abbreviations have been used:

b. Found in San Diego Bay.
♀ or ♂. Ripe female or male, or female with young if a viviparous species.
e. Eggs were procured (usually by skimming).
y. Young were taken.
a. Abundant.
f. Few.
c. Common.

Numbers ordinarily indicate the date of the month when specimens were seen. Thus, after No. 11, August 20, 28, indicates that specimens were taken on August 20 and 28. If a number is followed by an * it indicates the number of specimens taken. Thus, under No. 59, October 31, 1* indicates that one specimen was taken on October 31, etc.

Species.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1. Branchiostoma elongatum							a.					
2. Heterodontus francisci			27 ♀ b.									
3. Squalus acanthias							20 ♀	28 ♀				
4. Scylliorhinus ventriosus												
5. Galeus californicus		14 ♀ b.										27 e.
6. Triacis semifasciatus									7 ♀ b.			
7. Rhinotriacis henlei									6 ♀ b.	7 ♀ b.		
8. Galeorhinus zyopterus									7 ♀ b.			
9 Carcharhinus glaucus					14 b.			30 ♀ b.				
10. Carcharhinus lamiella												
11. Sphyrna zygæna								20, 28	7, 24			
12. Alopias vulpes											2*	
13. Squatina squatina	15	11		20								
14. Rhinobatus productus											22	
15. Rhinobatus exasperatus											22	
16. Rhinobatus triseriatus												
17. Urolophus halleri											22	
18. Pteroplatea marmorata												
19. Dasybatis dipterura											22	
20. Myliobatis californicus											22	
21. Manta birostris												
22. Phoxinus oreuttii												
23. Albula vulpes					25			7	10			19
24. Clupea mirabilis	♀											11 ♀
25. Clupea sagax	a.	a.			29 y.		21 y.		10 a.	a.	a.	a.
26. Perkinsia othonops				18 e.	e.	e.					20, 1*	
27. Stolephorus ringens												
28. Stolephorus delicatissimus			5	e.	a.-e.	a.-e.						
29. Stolephorus compressus			5	24 e. 26 e.	a.	a. 2 e. 15 e. 25 e.						
30. Synodus lucioceps		1*										
31. Tarletonbeania tenua									14 f.	f.	f.	f.
32. Diaphus theta	28 a.									31, 1*		
33. Stenobrachius leucopsarum	29 a.	14										2
34. Myctophum townsendi							28 a.					4, 27
35. Myctophum californiense							28 a.					
36. Catablemella brachychir							28 a.					
37. Salmo irideus												
38. Cyprinodon macularius												
39. Fundulus parvipinnis	a.	a.	a.	a.	a.	a.	a.	a.	a.	a.	a.	a.
40. Sidera mordax		13			1					15		
41. Tylosurus exilis				a. ♀	a.						f.	
42. Scomberesox brevirostris											1*	
43. Hemirhamphus rosæ	a.	a.	a.	a.	a.						15	
44. Exocœtus californicus							14	1				
45. Siphostoma punctipinne												
46. Siphostoma auliscus											22	
47. Siphostoma leptorhynchum											22	
48. Hippocampus ingens												
49. Gasterosteus microcephalus												
50. Mugil cephalus		f.			f. y.				y.		20	1 ♀ ?
51. Menidia tenius								10		a.	a.	f.
52. Atherinopsis californiensis	a. ♀	a. ♀										
53. Atherniops affinis	a.	a.	a.	a.	a. ♀	a. ♀		28	a.	a.	a. ♀	a. ♀
54. Sphyræna argentea		f.	27 a.		a o & b	a.	a. ♀	19	f.	a.	a.	a.
55. Remora remora								a.	a.	a.	f. y.	f. y. b.
56. Xiphias gladius									7			
57. Scomber colias	f.		1*		12*			1				
58. Scomberomorus maculatus								a.	a.	a.	a.	a.
								a.	9			

Species.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
59. Sarda chilensis	f.	f.	f.		13		a.	a.	a.	a.	a.	a.
60. Orcynus alalonga							a.	a.		31.1*		15.1*
61. Euthynnus pelamys												
62. Trachurus picturatus	4 f y b						3	f.		c.	c.	c.
63. Caranx chrysus caballus												
64. Seriola dorsalis				30	25			a.	a.	a.	c.	f.
65. Stromateus simillimus	f. y. b.				16.2*	1♂		a.	a.	c.	c.	a.y.b.
66. Paralabrax clathratus	c.		27		29			a.	a.	a.	a.	a.
67. Paralabrax maculofasciatus	a.	a.	27		29	♀		a. ♀		a.	a.	a.
68. Paralabrax nebulifer	a.	a.		21♂	29	♀		a. ♀	7	a.	a.	c.
69. Stereolepis gigas							15	1		f.	f.	
70. Xenistius californiensis					29.1*			a.	a.	9.1*		
71. Anisotremus davidsoni				20				28			a.	
72. Girella nigricans				17♂				f.		a.	f.	
73. Caesiosoma californiense					3♂							19
74. Roncador stearnsi		10 a						c.	c.		a.	a.
75. Sciæna saturna	f.	f.	27♂	a. ♀	a. e.	e.		e.	24			
76. Genyonemus lineatus	a. ♀	f.										27 a.
77. Umbrina roncador					25	a.		f.	f.			a.
78. Menticirrhus undulatus	9.1*	11.1*						f.		f.	f.	f.
79. Cynoscion nobile				20	a.			f.	f.	f.	f.	
80. Cynoscion parvipinne		1 y.		21	25			7	9	f.	f.	f.
81. Seriphus politus	a.	a.							10	a.	a.	a.
82. Gerres cinereus											1*	
83. Abeona minima	♀	♀										♀
84. Brachyistius frenatus					29							
85. Cymatogaster aggregatus	♀	♀	♀	♀								♀
86. Hyperprosopon argenteus	♀	?	?	?	?	?	?	?	a.	a.	a.	a. ♀
87. Holconotus rhodoterus	10.1*											
88. Amphistichus argenteus	♀	♀							a.	a.	a.12 ♀	a. ♀
89. Hypsurus caryi												♀
90. Embiotoca jacksoni	♀	♀									7 ♀	♀
91. Phanerodon laterale	♀	♀							28			
92. Phanerodon atripes												
93. Phanerodon orthonotus								1				
94. Phanerodon furcatum	a.	a.							a.	a.	a.	a.
95. Rhacochilus toxotes		3								3.1*		
96. Damalichthys argyrosomus	f.	f.										f.
97. Trochocopus pulcher	a.	a.					a.	a.	a.	a.	a.	
98. Platyglossus semicinctus								1.4		9		
99. Pseudojulis modestus								a.		29	21	
100. Pomacentrus rubicundus					3							
101. Chromis punctipinnis								28.1*				
102. Chætodipterus faber zonatus												
103. Caulolatilus princeps	f.	f.					a. ♀	a. ♀	a.	a.	a.	f.
104. Gobius nicholsi												
105. Lepidogobius gilberti	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.
106. Lepidogobius ycauda	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.
107. Clevelandia longipinnis	a.	a.	a.	a.	a.	a.	a.	a.	a.	a.	a.	a.
108. Gillichthys mirabilis	a.	a.	a.	a.	a.	a.	a.	a.	a.	a.	a.	a.
109. Typhlogobius californiensis	a.	a.	a.	a.	e. a.	e. a.	a.	a.	a.	a.	a.	a.
110. Ophiodon elongatus	♀ 30 f.	f.						f.	f.	f.	f.	f.
111. Zaniolepis frenatus								28				

Species.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
112. Sebastodes paucispinis	c. ♀	c. ♀	c.	.....	.....	.....	c.	c.	c.	c.	c.	c. ♀
113. Sebastodes flavidus	c. ♀	c.	.....	.....	.....	.....	c.	c.	c.	c.	c.	c.
114. Sebastodes serraniodes	c. ♀	c.	.....	.....	.....	.....	c.	c.	c.	c.	c.	c.
115. Sebastodes goodei	c.	r.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
116. Sebastodes rufus	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14	16 a.
117. Sebastodes ovalis	c.	c.	.....	.....	.....	.....	c.	c.	c.	c. ♀	f.	f.
118. Sebastodes mystinus	f.	26	.....	.....	.....	.....	.....	f.	24	c. ♀	a.	.....
119. Sebastodes proriger	.....	12	.....	.....	.....	.....	.....	.....	.....	.....	14. 6*	2. 1*
120. Sebastodes atrovirens	.....	.....	.....	.....	.....	.....	.....	23	.....	.....	.....	.....
121. Sebastodes melanostomus	.....	.....	.....	.....	.....	.....	.....	.....	.....	14. 1*	.....	.....
122. Sebastodes pinniger	2*	1*	.....	.....	.....	.....	.....	.....	.....	.....	.....	3*
123. Sebastodes miniatus	a. ♀	a. ♀	.....	.....	.....	.....	a.	a.	a.	a.	a. ♀	a. ♀
124. Sebastodes ruber	3*	2*	.....	.....	.....	.....	f. ♀	f.	f.	.....	f.	5*
125. Sebastodes rosaceus	f.	.....	.....	.....	.....	.....	f. a.	a.	f.	.....	f.	f.
126. Sebastodes constellatus	c.	c.	.....	.....	.....	.....	c.	c.	c.	c.	c.	2*
127. Sebastodes æreus	2*	.....	.....	.....	.....	.....	.....	.....	.....	.....	7. 2*	.....
128. Sebastodes chlorostictus	a.	a.	.....	.....	.....	.....	a.	a.	a.	a.	a.	a.
129. Sebastodes eos	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14	a.
130. Sebastodes gilli	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3*	.....
131. Sebastodes elongatus	c.	c.	.....	.....	.....	.....	c.	c.	1*	c.	c.	c.
132. Sebastodes levis	c. ♀	c. ♀	.....	.....	.....	.....	c.	c.	1*	c.	c.	c.
133. Sebastodes rubrovinctus	2*	3*	.....	.....	.....	.....	f.	f.	f. ♀	f. ♀	f. ♀	2*
134. Sebastodes auriculatus	f.	f.	.....	.....	.....	.....	f.	f.	f. ♀	f.	f.	3*
135. Sebastodes rastrelliger	.....	.....	.....	.....	.....	.....	.....	23. 1*	.....	.....	.....	.....
136. Sebastodes vexillaris	a. ♀	a. ♀	.....	.....	.....	.....	a.	a.	24	a.	a.	a.
137. Sebastodes chrysomelas	.....	f.	.....	.....	.....	.....	f.	f.	.....	1*	c.	.....
138. Sebastodes serriceps	f.	f.	.....	.....	.....	.....	f.	f.	.....	9	f.	1*
139. Scorpaena guttata	a.	a.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
140. Leptocottus armatus	a.	a.	a.	a.	a.	a.	a.	a.	a.	a.	a.	a.
141. Leiocottus hirundo	31. 1*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
142. Oligocottus analis	a. ♀	a.	a. 27 ♀	a.	a.	a.	a.	a.	a.	a.	a.	a.
143. Icelinus australis	.....	.....	.....	.....	.....	.....	.....	1. 2	.....	.....	.....	.....
144. Paricelinus hoplitticus	.....	.....	.....	.....	.....	.....	.....	1. 1*	.....	.....	.....	.....
145. Scorpaenichthys marmoratus	1*	.....	.....	.....	.....	.....	.....	.....	.....	1*	.....	.....
146. Brachiopsis sp	.....	.....	.....	.....	.....	.....	.....	1*	.....	.....	.....	.....
147. Gobiesox rhessodon	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
148. Gobiesox eigenmanni	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
149. Porichthys margaritatus	.....	f.	.....	f.	.....	.....	a.	a.	.....	.....	14	.....
150. Isesthes gentilis	.....	.....	.....	30	.....	.....	.....	.....	.....	.....	.....	.....
151. Isesthes gilberti	.....	.....	27 ♀	.....	.....	.....	.....	.....	.....	15	.....	.....
152. Heterostichnus rostratus	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.	c.
153. Heterostichus rostratus	f.	f.	27 ♀	.....	.....	.....	.....	f.	f.	f.	f.	.....
154. Auchenopterus integripinnis	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
155. Neoclinus blanchardi	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
156. Fierasfer dubius ?	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
157. Otophidium taylori	.....	1*	.....	.....	.....	.....	.....	e. a.	.....	.....	.....	.....
158. Merlucius productus	9. 2*	.....	.....	.....	.....	.....	.....	.....	.....	.....	6. 1*	.....
159. Citharichthys sordidus	c.	f.	.....	.....	.....	.....	.....	.....	.....	7. c.	c.	c.
160. Eopsetta jordani	10. 1*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
161. Paralichthys californicus	f.	f.	.....	.....	.....	.....	f.	f.	c.	c.	c.	c.
162. Hippoglossina stomata	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7. 2*	.....
163. Xystreurys liolepis	.....	.....	.....	.....	.....	.....	.....	.....	f.	3*	.....	.....
164. Pleuronichthys cœnosus	a.	a.	.....	c.	.....	.....	.....	a.	a.	a.	a.	a.
165. Hypsopsetta guttulata	a.	a.	.....	a. c.	a.	.....	.....	a.	28	a.	a.	a.
166. Symphurus atricauda	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	.....
167. Sphæroides politus	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
168. Diodon hystrix	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
169. Chilomycterus californiensis	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
170. Mola mola	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

GENERAL REMARKS ON THE INDIVIDUAL SPECIES.

I have endeavored to collate references to San Diego fishes.

BRANCHIOSTOMIDÆ.

Branchiostoma elongatum Sundevall.

Cooper, in Cronise, Natural Wealth of California. 498, 1868. Jordan & Gilbert, '81. 29 (not seen). As *B. lanceolatum*. Gill, Proc. U. S. Nat. Mus., v. 1882, 515; Rosa Smith, July, '85, 55. E. Am. Nat. 1892, 70.

Before 1891 three specimens of this species were known from San Diego Bay. They were taken by Dr. Cooper in 10 fathoms of water near Roseville. During July, 1891, I took a large number near Ballast Point, where a dredge was deepening the channel.

HETERODONTIDÆ.

Heterodontus francisci (Girard).

Jordan & Gilbert, '80, 34; Rosa Smith, July, '80a., 458., id., '82, 30. R. Smith, '85.

This species is very abundant at San Diego both in the bay and outside. The eggs are often driven ashore and lodged between rocks in tide pools or are thrown on the beach. Several eggs ready to hatch have in previous years been found during January. A female about 1 meter long opened March 27, 1889, by some fishermen, contained an egg inclosed in its twisted shell.

SPINACIDÆ.

Squalus acanthias Linnæus.

E. & E., '89,1; '89a, 12.

This species is very abundant at the Cortes Banks. One specimen, taken in July was with young, 22 millimeters long. One individual caught a short distance off Point Loma, January 9, 1890, was with young, 11 millimeters long. In these the external gills had already disappeared and the characteristic color of the adult was developed. It has not been seen in the bay.

SCYLLIDÆ.

Scylliorhinus ventriosus Garman.

Rosa Smith, '85. E. & E., '89, 13.

We have not seen the adult of this species at San Diego. The empty dried egg cases are frequently thrown up on the beach and occasionally live ones are found. They are extruded during December (February at Santa Barbara, J. & G.). The young have been described by us *l. c.*

It has not been taken in the bay.

GALEORHINIDÆ.

Galeus californicus (Gill).

J. & G. '80, 34, as *Mustelus californicus;* R. Smith, '80, *Mustelus hinnulus.* J. & G. '80a, 458; *id.* '81a, 31. R. Smith, July, '85.

This species is quite common in San Diego Bay. A specimen caught with hook and line, February 14, 1890, was with young. There were fourteen and the yolk was all or nearly all absorbed. The specimen was mutilated and the young had been taken from it when it was examined. They were evidently nearly ready to be freed.

Triacis semifasciatus Girard.

J. & G. '80, 34; R. Smith, '80; J. & G. '80a, 458; *id.* '81, 31; R. Smith, '85, July. E. & E. '89a, 13.

The females of this species are abundant in the bay during summer and are frequently taken with hook and line. A few are also found in winter. Embryos in advanced stages were taken from the mother in September and October. The young have been described *l. c.*

Rhinotriacis henlei Gill.

E. & E., '89a, 13.

A single specimen of this species was taken with hook and line September 7, 1889. It contained but three embryos in either uterus, each 115 millimeters long.

Galeorhinus zyopterus Jordan & Gilbert.

R. Smith '80, as *G. galeus;* J. & G. '80a, 458; *id.* '81, 32; *id.* '82, 871; R. Smith '85, July; E. & E. '89a, 13.

Common in the bay in summer or during the early part of gestation. Two females taken August 30, 1890, had young 50 millimeters and 80 millimeters long respectively. One specimen was taken off Point Loma, February 14, 1890.

Carcharhinus glaucus (L.).

E. & E. '89, 1.

Three large specimens, nearly 3 meters long, were taken in San Diego Bay May 14, 1889. It was found to be quite abundant on the Cortes Banks during July and August.

Carcharhinus lamiella Jordan & Gilbert.

R. Smith '80; J. & G. '80a, 458. J. & G. '81, 32 all as *Eulamia lamia.* J. & G. Proc. U. S. Nat. Mus. v. 110, 1882, as *Carcharias lamiella; id.* '82, 60 as *Eulamia lamia,* and 873 as *C. lamiella.* R. Smith, '85, July.

Only two specimens of this shark have been taken as yet. They were procured by Jordan & Gilbert in 1880.

SPHYRNIDÆ.

Sphyrna zygæna (L.).

E. & E. '89a, 10 and 11.

This species is not uncommon during summer. A large specimen was taken on the Cortes Banks in August. One was caught in the bay on September 6 and others were taken off Point Loma August 28 and September 24. It seems to be always accompanied by *Echeneis remora*.

ALOPIDÆ.

Alopias vulpes (Gmelin).

Two specimens of this species were taken in the fall of 1890.

SQUATINIDÆ.

Squatina squatina (L.).

R. Smith '80; J. & G. '80a, 458; *id.* '81, 33; R. Smith '85, July.

This species is probably found in the bay throughout the year. It is not infrequently caught off the wharves. Specimens were seen on April 20, 1889, and January 15 and February 11, 1890.

RHINOBATIDÆ.

Rhinobatus productus Ayres.

J. & G. '80, 34; R. Smith '80; J. & G. '80a, 458; *id.* '81, 34; *id.* '82, 876; R. Smith '85, July.

Caught off the wharves in spring.

Rhinobatus exasperatus Jordan & Gilbert.

J. & G. '80, 32; R. Smith '80; J. & G. '80a, 458; *id.* '81; *id.* '83, 63 and 876; R. Smith '85, July.

Common in the bay.

Rhinobatus triseriatus Jordan & Gilbert.

R. Smith, '80; J. & G., '80a, 458; *id.*, '81, 34; *id.*, '82, 64; R. Smith, '85, July.

Not uncommon in the bay.

DASYBATIDÆ.

Urolophus halleri Cooper.

J. & G., '80, 31; R. Smith, '80; J. & G., '80a, 457; *id.*, '81, 35; *id.*, '82, 46; R. Smith, '85, July.

Very common.

Pteroplatea marmorata Cooper.

J. & G., '80, 31; R. Smith, '80; J. & G., '80a, 457; *id.*, '81, 35; *id.*, '82, 47; R. Smith, '85, July.

Common.

Dasybatis dipterura Jordan & Gilbert.

J. & G., '80, 31; R. Smith, '80; J. & G., '80a, 457; *id.*, '81, 35; *id.*, '83, 48; R. Smith, '85, July.

One specimen taken with hook and line in October, 1889; another in a seine November, 1890.

MYLIOBATIDÆ.

Mybliobatis californicus Gill.

J. & G., '80, 31; R. Smith, '80.

Common.

MANTIDÆ.

Manta birostris (Walbaum).

No authentic specimens have been recorded from here.

Jordan & Gilbert credit it to San Diego on the authority of whalers. Mr. Medina claims to have seen one about five years ago. None of the other fishermen know anything about it.

CYPRINIDÆ.

Phoxinus orcuttii Eigenmann & Eigenmann.

E. & E., 90, 2.

This species is very abundant in the Temecula River, at the Temecula station, and in its tributaries. Some specimens were also found at San Bernardino.

ALBULIDÆ.

Albula vulpes (Linnæus).

J. & G., '80, 30; R. Smith, '80; J. & G., '80a, 457; *id.*, '81, 37; *id.*, '82, 258; R. Smith, '85, July.

This species has not, at any time during the past year, been abundant at San Diego. It is occasionally caught during the summer and early spring. A few specimens were taken September 10 and it was not seen again till December 19, when a single small individual was taken. I have not seen it with ripe sexual elements.

CLUPEIDÆ.

Clupea mirabilis Girard. (Plate XI.)

J. & G., '80, 30; R. Smith, '80; J. & G., '80a, 457; *id.*, '81, 37; *id.*, '82, 265; R. Smith, '85, July. Eigenmann, Am. Nat., 1, March, 1889.

This species entered San Diego Bay September 11, 1889, and no more were seen after February 15, 1890. It spawns probably during the whole time of its stay here, as ripe females were seen the first and last days it was taken. The young have not been observed in the bay during summer. The whole of the catch is sold fresh.

On January 3, 1888, a ripe male and a ripe female were procured, and although the fish had been dead some time fertilization was success-

fully attempted. The eggs are very adhesive, and come from the ovary in long strings. Shortly after they have been deposited they lose their adhesive power, and if they are then freed from the objects to which they have become attached they do not adhere again.

The membrane at the time of deposition is greatly shriveled and does not become distended till some time afterwards.

The yolk is collected in small spheres; it is grayish while the protoplasm is yellow and collects at the side of the egg. This fact enables one to trace the formation of the germinal disk quite readily. In an hour the protoplasm is well collected at the ectodermal pole, while processes extend from it over the yolk and others probably in between the yolk spheres. Frequently there is also a slight thickening of protoplasm over the *entodermal* pole. The fate of this has not been determined. Fig. 4.

One hour and fifty minutes after fertilization one of the eggs began to segment. The segmentation furrow descends slowly, producing slight folds on the surface of the blastomeres on either side of the furrow. With the descent of the furrow the blastomeres become more and more separated. When the furrow has reached the base of the germinal disk it slowly closes up again, the blastomeres becoming closely appressed. At one hour and fifteen minutes from the beginning of the first segmentation the second furrow appears. At one hour and forty-five minutes the third cleavage has been completed in several eggs. (Fig. 15.) It is now seen that the segmentation is not quite symmetrical, and the third cleavage, which invariably leaves eight cells in pelagic eggs in this case, produces five or six or seven as well as eight, and these are not very regularly arranged. This fact is undoubtedly due to the hastening of the segmentation in some cells and the retardation in others.

The development of this species does not differ greatly from that of the shad, and the accompanying figures probably sufficiently illustrate the different stages.

The meridian of the embryo comes to lie in a horizontal plane.

Two days after fertilization the embryo begins to move and the heart beats.

Six days and a half after fertilization one of the membranes was empty, but the fish could not be found. The remaining embryos remained active in the shells five days longer when all of them died.

The larvæ or young of this species I have never found.

Clupea sagax Jenyns.

J. & G., '80, 30; R. Smith, '80; J. & G., '80a, 457; *id.*, '81, 37; *id.*, '82, 265; R. Smith, '85, July.

This species enters San Diego Bay about the first of September (large ones were first seen the past season on September 10) and remains till some time in March. Large schools of them are found about the wharves. Few are caught in seines, and many of these are

not utilized. Some are caught with grab hooks off the wharves, and are sold at 5 cents per dozen. They reach a length of 0.30 m.; but few specimens of such size are caught. At times they are in such abundance that bushels of them are left at low tide in the small puddles about piles.

Young ones remain in the bay during the summer.

The spawning season has not been ascertained.

Perkinsia * **othonops** R. S. Eigenmann.

American Naturalist, February, 1891.

One specimen was obtained with hook and line among mackerel in November, 1890.

STOLEPHORIDÆ.

The members of this family are probably found here throughout the year, but they are certainly much more abundant in spring and summer than in winter (if they are here in winter at all). During spring and summer they furnish a large per cent of the food of all the larger fishes. The species inhabiting San Diego waters may be distinguished by the following key:

a. Spindle-shaped, form of *Clupea sagax*, no silvery lateral band, bluish above, not translucent. A. 22; Head 3½. Ova oval. Young more compressed, sides silvery but without well-defined band, not translucent ..... *ringens.*

aa. Strongly compressed, a silvery lateral band, translucent in life. Head 4½.

b. A. 23; depth 4¾. Ova oval ..... *delicatissimus.*

bb. A. 31; depth 3¾. Ova round ..... *compressus.*

The pelagic eggs of these species are the most striking feature of the surface fauna in April, May, and June. The oval eggs were first obtained on April 18, and on account of their bizarre appearance were at first set aside as not fish eggs, but the gastrulation soon convinced me that they were. They are so abundant during May that quantities have been obtained simply by several times throwing the skimming net over the water and drawing it in while standing on the float of a boat-house. The oval eggs of *delicatissimus*, *ringens* were the first to appear, the round eggs of *compressus* appear later. The yolk is collected in clear transparent spheres.

Stolephorus ringens (Jenyns). (Plate XII).

Girard, Pacific R. R. Survey x. 334, 1859 (as *Engraulis mordax*) J. and G., '80, 30; R. Smith '80; J. and G. '80*a* 457; *id.* '81, 36; *id.* '82, 272. R. Smith '85, July; E. and E. Contrib. San Diego Biol., Lab. I, West Am. Scient., June, '89.

This is the largest anchovy found at San Diego. It is found in the bay in summer and ranges from the surface to a depth of about 100 fathoms in the ocean off Point Loma. It is found in the stomachs of

* This genus is dedicated to the Hon. George C. Perkins, of San Francisco, ex-governor of California, who has for many years materially aided scientific research in the State of California.

pelagic species like the albicore and in that of the bottom fishes like the species of *Sebastodes*.

Specimens of this species are even more numerous in the summer in the bay than *Clupea sagax* in winter. They swim in large schools and frequently when frightened by large fishes below them or for other reasons the heads of a whole school of them will be thrust out of water. The pelicans at this time dive in among them and catch large numbers. Schools of *Tylosurus exilis* flank them and by sudden darts catch many. They are thus beset on all sides by enemies. They feed on crustacea and larval fishes.

I have not definitely decided which of the oval eggs belong to this species and which to *delicatissmus*.

Stolephorus delicatissimus (Girard). (Plate XII.)

Girard, Proc. Acad. Nat. Sci. Philad. VII, 1854, 154 and Pacific R. R. Survey X, 325, 1859; J. and G. '80, 30; R. Smith '80, J. and G. '80*a*, 457; *id.* '81, 38; *id.* '82, 276; R. Smith, '85, July; E. and E. Contrib. San Diego Biol. Lab., I, West Am. Scient., June, 1889.

This species is very abundant in San Diego Bay. I have not determined whether it remains throughout the year or not. It certainly is very common during summer or from March to September. Jordan and Gilbert have found it abundant here in January.

DEVELOPMENT OF STOLEPHORUS DELICATISSIMUS AND RINGENS.

(Plate XII.)

The eggs of these two species differ from most other pelagic eggs in their elongate shape. The eggs are transparent. The yolk is totally segmented. The eggs vary greatly in size and shape, and at first I supposed them to be three distinct species. The measurements are 0.81 by 0.57 millimeters, 0.89 by 0.49, and 0.70 by 0.50. Oval eggs which may be referred to this genus have been described by M. Kowalewski,* Wenckebach,† and Raffaele ‡ (who correctly identifies them). Agassiz & Whitman § have described a species of Stolephorus as an Osmerus.

The eggs of Osmerus are provided with a peculiar double zona, the outer layer of which is reflexed at the time of spawning, and remains attached to the inner part around the micropyle.

These are the most abundant of the pelagic eggs found at San Diego. During their season a number could be procured at any time by throw-

* Ueber die ersten Entwickelungsprocesse der Knochenfische. Zeitschr. f. Wissensch. Zoöl., 1883.

† Beiträge zur Entwickelungsgeschichte der Knochenfische. Arch. Mikr. Anat. XXVIII, 1886.

‡ Le nova galleggianti e le larve dei Teleostei nel golfo di Napoli. Mitth. Zoöl. Stat. Neaple, VIII, 1888.

§ The Development of Osseus Fishes, I. Mem. Mus. Comp. Zool. 1885.

ing the net from the wharf as far as it would reach and drawing it in again. They were first noticed April 18, 1889, when eight eggs were found. They soon became very abundant and remained so until July.

There is but a small water space in the egg membrane, and the germ lies at the end of the longer axis of the egg just beneath the micropyle.

The physiological axis of the egg, therefore, corresponds to its longer structural axis.

The fertilization and the earliest stages in the segmentation were not observed in any of the pelagic eggs. All the eggs found had evidently been deposited in the evening. The segmentation progresses rapidly, being completed in about eleven hours. At this time the blastoderm rests on the periblast only on its outer margins. The periblast dips deeply into the yolk, leaving a large, concavo-convex-shaped segmentation cavity, to the bottom of which cells from the blastoderm sometimes fall (Fig. 1). This is probably the stage termed the "blastula" by Ryder. Some time after the infolding of the margin of the blastoderm the segmentation cavity is almost entirely obliterated by the ingrowing cells. The inner margin of the embryonic shield reaches beyond the middle of the blastoderm, and by the time the blastoderm covers half the yolk the embryo extends entirely across the ectodermic end of the yolk (Figs 2 and 3). The anterior and posterior margins of the embryonic ring extend evenly over the yolk and the blastopore closes at the entodermic pole.

M. Kowalewski concluded, from several preserved oval eggs, that the posterior margin advanced but little, while the anterior edge moves over the greater portion of the egg, the blastopore closing near the ectodermic pole. It would seeem that such a closing of the blastopore would be somewhat precipitous after the embryonic ring had passed the entodermic pole of the egg. He has superimposed the stages in his possession in a single figure. The latest stage—one about corresponding to a stage intermediate between my Figs. 9 and 10—he has drawn upside down, which would bring the closing of the blastopore about where the auditory capsule of my Fig. 10 comes to lie. His first two stages are either pathological (which would account for the eccentric positions of the blastoderm), or the blastodisc in the species studied by him is normally placed to one side of the exact mechanical pole of the egg.

In the eggs observed by me the tip of the head soon comes to a state of rest while the posterior growing end of the embryo advances over the yolk.

The blastopore closes in about eighteen hours. Kupffer's vesicle disappears in about twenty-four hours. At the closing of the blastopore the embryo extends somewhat more than half way around the yolk.

The embryo hatches in about forty-eight hours and measures 1.79 millimeters. The tail is sharply bent down over the yolk, making almost a right angle with the axis of the body, so that the vigorous

motion of the tail causes the embryo to revolve around its snout as a pivot.

At this time the lateral organs show as four or five hyaline projections on either side of the body. On treating the eggs with Perenyi's fluid just before hatching, the contents of these cells become granular. The embryo contracts and a slender thread, the *nervus laterale*, can be seen connecting them. Slender roots are also seen extending from these cells to the embryo.

The yolk is rapidly reduced in size and the embryo doubles its length in about twenty-four hours. The oldest larva examined is represented in Fig. 14, forty-eight hours after hatching.

Pigment does not appear in these eggs or larvæ during the time that they were examined.

In the segmented yolk these eggs agree with those of the shad and other physoclistic fishes.

Stolephorus compressus (Girard).

Girard, Pacific R. R. Survey, X, 336, 1859.
R. Smith '80; J. and G. '80*a*., 457; *id.* '81, 37; *id.* '82, 276; R. Smith '85, July; E. and E., l. c., June, 1889.

Quite common, but not so abundant as *ringens* or *delicatissimus*.

DEVELOPMENT OF STOLEPHORUS COMPRESSUS.

(Plate x, Figs. 1–5).

The eggs of this species can readily be distinguished from other pelagic eggs. They are spherical, transparent, without oil globules, and with a totally segmental yolk. They measure 0.76 millimeter. A single egg of this species was found April 24 and is represented in Fig. 1. The next appearance of these eggs was on April 26, when two eggs were found, the one represented in Fig. 2 the other in Fig. 4. The one represented in Fig. 2 hatched in about sixty hours. The time required for hatching was considerably reduced in eggs found later, doubtless owing to the rise in temperature. More eggs were found on June 2, and from June 15 to 25 they were very abundant.

On hatching these fishes resemble the other species of *Stolephorus*, and but little difference can be made out between the species during the first twenty-eight hours after hatching. Up to this time no sign of pigment has appeared.

SYNODONTIDÆ.

Synodus lucioceps (Ayres).

This species is never very abundant at San Diego and has not been recorded from here until the present year. It was first observed by me on September 14, 1889, and it was caught with hook and line and with seines at an average of about one a day till the 17th of December. None were observed after that until February 11, 1890, when a single specimen was taken. It was most abundant during November.

SCOPELIDÆ.

Three species of this family were taken at the Cortes banks and three in the neighborhood of San Diego. All were taken from the mouths of Rock Cod. They are not found in the regions inhabited by Rock Cod except on stormy days, and it is only during rough weather, therefore, that they can be procured. The explorations of the *Albatross* would seem to show that in deep water there lives still another series of this family.

The littoral species of this family, known from the Pacific coast of America, may be distinguished by the following key:

a. Lat. l. none. Greatly compressed. Scales crenulate..... *Tarletonbeania* E. & E.
b. Origin of dorsal equidistant from tip of snout and base of caudal peduncle; ventrals reaching half way to 7th anal ray; no spines on caudal peduncle; dorsal and ventral profiles equally arched. *Tenia* E. & E.
bb. Origin of dorsal nearer snout than base of caudal; ventrals not reaching half way to vent; caudal peduncle with three spines above and below; ventral profile more strongly arched than dorsal profile. ..... *Crenulare* J. & G.
aa. Lat. l. present.
c. Phosphorescent spots thetaform..... DIAPHUS E. & E.
d. Pectorals small, not reaching ventrals, inserted low. D. 11. A. 12. Lat. l. 34. Head 3½; depth 4. Snout blunt. Orbit 3 in head, ⅔ in interorbital. Scales entire. A conspicuous phosphorescent spot before each eye..... *Theta* E. & E.
cc. Phosphorescent spots normal.
e. Scales of lat. l. enlarged..... STENOBRACHIUS E. & E.
f. A. 14. lat. l. 36. Eye 4 in head, 1 in interorbital. Head 3½. D. 13. Light gray, finely dotted with black. Deep forward, decreasing evenly to caudal peduncle, which is 2 in the greatest depth..... *Lucopsarum* E. & E.
ee. Scales of lat. l. not enlarged.
g. Pectoral inserted high. Dorsal not longer than anal. MYCTOPHUM Raf.
h. A phosphorescent spot at base of middle caudal rays. Pectoral narrow, reaching origin of anal. Ventrals to the vent..... *Townsendi* E. & E.
hh. No phosphorescent spot at base of middle caudal rays.
i. Pectoral not reaching second third of ventral. Ventrals to vent. Lat. l. 42..... *Californiense* E. & E.
ii. Pectoral large, broad, reaching vent. Ventrals not to vent. Lat. l. 38..... *Boops* Rich.
gg. Pectoral small, inserted low, the upper margin scarcely higher than origin of ventrals. Dorsal longer than anal. Eye 4 in head.. ..... CATABLEMELIA *Brachychir* E. & E.

Tarletonbeania tenua Eigenmann and Eigenmann.

E. & E., '90, 7.

This species is at present known from a single well-preserved specimen taken off Point Loma. U. S. Nat. Mus. No. 41882.

Diaphus theta E. & E.

E. & E., '90, 4.

This species is quite abundant. A single specimen was obtained off Point Loma, December 2, 1889, and a number of specimens on the 28th

and 29th of January, 1890. It is known from the types only. U. S. Nat. Mus. Nos. 41914 and 41922.

In the structure of its phosphorescent spots it stands unique among the North American scopeloids.

Stenobrachius leucopsarum E. & E.

E. & E., '90, 4. *Myctophum nannochir* Gilbert.

This is the most abundant species found near Point Loma. Specimens can be procured almost any rough day from the mouths of Rock Cod. It has been procured on December 4 and 27, 1889, and on January 28 and 29, 1890. During the last two dates it was quite abundant. U. S. Nat. Mus. No. 41916.

Myctophum townsendi E. & E.

E. & E., '89, 2.

This appears to be the most abundant scopeloid on the Cortes Banks, where a number were obtained from the mouths of Rock Cod in July, 1889, just after a heavy "nor'wester." It is known from the types only. U. S. Nat. Mus. No. 41921.

Myctophum californiense E. & E.

E. & E., '89.

This species was procured with *M. townsendi* on the Cortes Banks. It is known from the types only. U. S. Nat. Mus. No. 41920.

Catablemella brachychir E. & E.

E. & E., '89, 3; *id*, '90.

This species is known from the specimens taken with the preceding two on the Cortes Banks. In general appearance it does not differ much from *Myctophum*. The position of the pectoral warrants, however, a generic separation. U. S. Nat. Mus. No. 41915.

SALMONIDÆ.

Salmo irideus Gibbons.

R. Smith, '80 (Pala); J. & G., '81, 38; *id.*, '82, 312; R. Smith, '85, July.

This is one of the three or four species of fresh-water fishes known from the western slope of San Diego County. It is abundant in the streams rising in Smith Mountain and emptying into the San Luis Rey River. It also occurs in the mountain streams east of San Quentin, Lower California.

CYPRINODONTIDÆ.[*]

Fundulus parvipinnis Girard.

Girard, Proc. Acad. Nat. Sci., Philad., 1854., 154, and Pacific R. R. Survey, x, 303, 1859; Günther, Cat. Fish., vi, 319, 1866; Steind., Ichthyol. Beitr., v, 153, 1875; J. & G., '80, 30; R. Smith, '80; J. & G., '80a. 357; *id.*, '81, 42; *id.* '82, 333; R. Smith, '85, July.

Very abundant in the bay of San Diego and Elsinore (fresh) Lake.

[*] *Cyrinodon macularius* Girard. Specimens of this species were collected by Mr. C. R. Orcutt on the Colorado Desert. Others were collected by Mr. F. Stephens.

MURÆNIDÆ.

Sidera mordax (Ayres).

J. & G., '80, 30; R. Smith, '80; J. & G., '80a, 357; id. '81, 36; id, '82, 356. R. Smith, '85, July.

Not common. Very rare in the bay.

I have not collected this species in tide pools. It seems to be common on rocky places of the ocean beach. It was taken in the bay on May 1 and October 15, 1889.

BELONIDÆ.

Tylosurus exilis (Girard).

Girard, Proc. Acad. Nat. Sci., Philad., 1854, 149, and Pacific R. R. Survey X 158, 1859; Günther Cat. Fish vi, 238; J. & G., '80, 30; R. Smith '80; J. & G. '80a, 357; *id.* '81, 43; *id.*, '82, 374; R. Smith, '85, July.

This species is very common in San Diego Bay during April and May, when it swims in schools on the surface. Schools are frequently seen flanking schools of Anchovies. Ripe or nearly ripe eggs were obtained in the middle of April, and in May they flow quite freely. (J. & G. give the spawning season as August.) I have not been able to artificially fertilize the eggs nor have I found them developing naturally. The species is very rare in winter, I did not notice it later than October. Jordan & Gilbert procured a specimen in January.

On account of its "green backbone" it is not used as food. The egg is large, amber colored, 2.4 mm. in diameter. The zona radiata is provided with long tapering filaments set in basal sheaths.

Scomberesox brevirostris Peters.

R. E., Am. Nat. 1891, 59.

One specimen of this species was procured for me by Mr. Medina during the summer of 1890.

Hemirhamphus rosæ Jordan & Gilbert. Swordfish.

J. & G. '80, 29; *id.*, Proc. U. S. Nat. Mus., III, 1880, 335; R. Smith, '80; J. & G., '80a, 357; *id.*, '81, 43; *id.*, 82, 376; E. Am. Nat., Feb. '91.

This species is common in the bay throughout the year. Like its relative, *Tylosurus exilis*, it swims in schools of about a dozen on the surface during the early portion of the year and during summer. During the latter part of summer and during fall it is not seen, living in deeper water. We have seen schools as early as January 17.

It probably spawns early in the year. Young were procured with the surface net during April and May.

Exocœtus californicus Cooper.

R. Smith, '80; J. & G., '80a, 357; *id.*, '81, 42; *id.*, '82, 379; R. Smith, '85, July. E. & E., Notes from San Diego Biol. Lab., I, 4, 1889.

This species is not uncommon off Point Loma and on the Cortes Banks during summer. It does not enter the bay and is not caught for the market.

SYNGNATHIDÆ.

I have little to say concerning the members of this family. They are always very abundant, but I have observed them only once or twice while with the seiners, and while skimming for pelagic eggs.

Sĭphosotma punctipinne (Gill).

Gill, Proc. Acad. Nat. Sci., Philad., 1862, 283; J. & G., '81, 69; *id.*, '82, 385; R. Smith, '85, June.

Only the types known.

Siphostoma auliscus Swain.

R. Smith, '85, June.

Common.

Siphostoma leptorhynchum Girard.

Girard, Pacific R. R. Survey, x, 345, 1859. J. & G., '80, 23; R. Smith, '80; J. & G., '80a, 453; July, '81, 69; *id.*, '82, 384; R. Smith, '85, June.

This is by far the commonest species of pipefish in the bay. Several are always taken in summer with the dredge, while the seine always brings them.

Hippocampus ingens Girard.

Girard, Pacific R. R. Survey, x, 343, 1859. J. & G., '80, 23; R. Smith, '80; J. & G., '80a, 453; *id.*, '81, 69; *id.*, '82, 386; R. Smith, '85, June.

We have never taken this species and have seen no specimens which certainly came from San Diego. It is said to occur about the Coronado Islands.

GASTEROSTEIDÆ.*

Gasterosteus microcephalus Girard.

R. Smith, '85, June.

This species has not been observed by us during the year. It was taken by Rosa Smith in Wildcat Cañon, a tributary of the Tia Juana River.

MUGILIDÆ.

Mugil cephalus L.

Steind., Ichthyol. Britr. III, 58, 1875; J. & G., '80, 29; R. Smith, '80; J. & G., '80a, 457; *id.*, '81, 76; *id.*, '82, 403; R. Smith, '85, July.

This species becomes abundant about the middle of February. It then enters the bay and ascends the swollen coast streams. The exact time of spawning has not been determined. One ripe female was reported to us on December 10 by a fisherman, who had never noticed it with eggs at other times. The young remain in the bay throughout the year, and are found chiefly in the sloughs of mud flats.

* *Aulorhynchus flavidus* (Gill) has been described to be by fishermen. I have not seen it.

ATHERINIDÆ.

Menidia tenuis (Ayres).

J. & G., '80, 29; R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 43; *id.*, '82, 405; R. Smith, '85, July; E. & E. '89a.

This species was observed from August to December. Jordan & Gilbert procured it in January. We have not seen it during spring and summer. It is not frequently brought into the markets.

Atherinopsis californiensis Girard. (Plate XIII.)

Girard, Pacific R. R. Survey, x, 103, 1859. J. & G., '80, 29; R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 44; *id.*, '82, 409; R. Smith, '85, July; Eigenmann, Am. Nat., March, 1889.

During its season this is one of the important food fishes of San Diego. It reaches San Diego the latter part of August, although but few enter the bay before November. It becomes abundant in October and remains so through January. The exact date of its disappearance has not been determined; large individuals have been seen as late as February 24. Some females are with ripe spawn as early as the beginning of November and others do not spawn till the middle of February, and farther north the spawning season is still later. Ripe females have been observed by us at San Pedro in March, and others in the San Francisco markets as late as May. During January and February the young of this species occur in enormous numbers along the muddy beaches of the bay, and a pail of water dipped at random frequently contains a dozen or more of them.

I have succeeded in artificially fertilizing this species, but have not succeeded in hatching the eggs. I have not found the eggs in their natural position. The stages reached by the eggs artificially fertilized and the larvæ dredged enable me to give a tolerably complete outline of the embryonic and larval stages of this species.

The eggs and milt of this species were taken from living fish and artificially fertilized at 4 p. m., December 31, 1889.

The zona radiata of this, as in all other species of the Atherinidæ, is provided with long filaments which taper slightly toward the tip; at the base they are expanded into a broad hollow disk, a projection of the zona fitting into the hollow of the filament. (Pl. XIII.) There are about ten of these filaments, and they are scattered evenly over the whole surface of the zona. In the green eggs they are closely coiled as parallels of latitude, being less regularly coiled at the poles. In the ripe eggs they are uncoiled, and the green ones can therefore be readily separated. At the time the eggs are deposited a large number of globules are scattered over the yolk; these, however, soon collect in two groups, one at the top of the egg and one at or near the entodermic poles.

Very frequently the eggs assume such a position that their axes are

horizontal. The micropyle can, in these cases, most usually be found and the formation of the blastodisk observed.

In pelagic eggs, in which the blastodisk invariably forms on the lower surface of the yolk, its formation might in part be explained by gravitation; not so in *Atherinopsis* and *Clupea*, where it forms at the side of the yolk. In later stages it is seen that this is the normal position of the germ, for even if one succeeds in bringing it to the top of the egg, the egg slowly rotates, the oil globules changing position until the germ lies again at the margin. The process of the formation of the germ differs considerably from that in *Clupea*. After the water space is formed a contraction begins near the ectodermal pole and travels to that pole. This is repeated rythmically. One series or one of the waves is represented in Figs. 2–7. In Fig. 2 the contraction has begun; in Fig. 5 it has reached its culmination, and in Fig. 7 it has ended and another is about to begin.

The first cleavage is completed after about three hours and twenty-five minutes from fertilization; twenty minutes afterward four cells are formed.

The sixteen-cell stage is reached in four hours forty-five minutes; thirty-two cells are formed five hours and ten minutes afterward. The first horizontal furrow was noticed after six hours, and the "blastula" (Fig. 12) after twenty-eight hours. This figure is seen but a very short time; it is apparently formed by the sinking of the yolk below the center of the blastoderm. Cells from the overlying blastoderm frequently fall to the bottom of this segmentation cavity. The cavity is apparently obliterated by the settling down of the cells overlying it; immediately after its disappearance the blastoderm spreads and its margins begin to be infolded. At this stage periblast nuclei are very abundant and extend over half the yolk; twelve hours afterward they have apparently decreased in number and are much larger in size.

The blastopore closes after about eighty hours. Kupffer's vesicle appears on the fourth day, the heart on the seventh; on the twelfth the embryos move vigorously; on the sixteenth day pigment spots appear on the top of the head and along the median line of the back. At this stage the embryos died, but the further developement may be gathered from the accompanying figures of larvæ procured by skimming with the surface net.

Atherinops affinis (Ayres). Top smelt.

J. & G. '80, 29; R. Smith '80; J. & G. '80a, 456; *id.* '81, 43; *id.*, 82, 409.

This species is found in San Diego Bay throughout the year. It is abundant through winter and spring, but is not esteemed as highly as the smelt. Large numbers are taken with seines. They spawn in May and June. The larvæ are abundant in the bay, but its development has not been traced. From their habit of keeping near the surface, especially surrounding offal, they are termed Top Smelt.

SPHYRÆNIDÆ.

Sphyræna argentea Girard. Barracuda.

Girard, Pacific R. R. Survey, x 39, 1859; Steind. Ichthyol., Beitr., VII, 1, 1878. J. & G., '80, 29; R. Smith, '80; J. & G., '80a, 456; *id.* '81, 44; *id.* '82, 41; R. Smith, '85. E. Zoe, April, '90.

This is one of the most important food fishes of the whole of southern California. In summer it is abundant on the whole coast of California from Monterey southward, but it is probably more abundant southward than in the neighborhood of Monterey. During the winter it disappears from the coast of California, but is taken on the coast of Lower California. It probably migrates bodily southward, but stray individuals undoubtedly remain in the waters of southern California throughout the year, for two or three days of exceptionally fine weather invariably brings them into the market. It is likely that these stray individuals live in deep water during the winter, and come to the surface on bright days. It is quite possible, though not probable, that a great part of those disappearing descend to deeper water. The fact that they are taken only by the troll or by gill nets sufficiently explains why they should not be caught in deep water.

Their movements have been watched through an entire season at San Diego, and as these observations may be valuable to serve as a basis for comparison, they may be stated here.

During January, 1890, none were seen. During February, 1890, four were taken on the 7th, one on the 11th, and two on the 28th. All these dates were at the end of a succession of days of exceptionally fine weather. On March 1, 1890, two were taken. On March 26, 1889, a few were caught, and on the following day they were abundant and remained so, with occasional lapses, throughout the summer. At the beginning of July they were with ripe spawn.

During September few were taken, but on the 29th, 30th, and 31st of October they were again abundant. On November 6 one was taken, on the 7th another, on the 15th one young one was caught with a hook in the bay, and on the 18th another young one was brought from off Point Loma. On the 16th of December, one young individual, evidently of the preceding summer's spawning, was taken in the bay, and on the 30th a large one was caught off Point Loma.

The adult never or very rarely enter the bay, but in spring the young, those not yet a year old and measuring about a foot in length, enter the bay in large schools, and are then destroyed in quantities with seines or Chinese bag nets.

About San Diego the troll is the only means used in catching them. It is simply a piece of white rag, or, more commonly, a fragment of bone, to which a hook is lashed. One or more of these is dragged behind a boat made usually after the pattern of the Columbia River salmon boats. The amount of the catch depends largely on the wind. A

slack wind, even when barracuda are abundant, brings but few fish. The largest catch reported for a single day is 1,100 by one boat with two men. Rarely more than 40 are taken. They average from 6 to 12 pounds, and from $2\frac{1}{2}$ to 4 feet in length, and retail at 10 cents apiece. Large numbers are salted and dried.

About Monterey they are taken with the gill net. In 1890 the first individuals reached Monterey on March 10.

Like most of the surface and shore food fishes the barracuda feeds chiefly on the anchovy (*Stolephorus ringens*).

Among Mrs. Eigenmann's notes is the following: *S. argentea* 8 to 12 inches long, abundant about San Diego steamship wharf, where they were taken by trolling, May 17, 1885.

ECHENEIDIDÆ.

Remora remora (Linnæus).

E. & E. '89a.

This species is common in summer when sharks abound. It is usually attached to *Sphyrna zygæna*. On other sharks it has not been observed.

XIPHIIDÆ.

(**Xiphias gladius** Linnæus).

E. & E. '89a.

This species has never, to my knowledge, been brought into the markets of San Diego. I have observed it on the Cortes Banks, as well as farther northward.

SCOMBRIDÆ.

Scomber colias Gmelin.

Steind. Ichthyol. Beitr. III, 53, 1875; *Scomber pneumatophorus*, J. & G., '81, 45; *id.* '82, 424; R. Smith, '85; E. & E. '89.

This species is quite abundant at San Diego. During August several fishermen reported large schools off Point Loma, and the bay was literally full of tinkers. They are caught in seines and with hook and line. One boy caught, in the latter way, one hundred and eighty tinkers in one hour. The tinkers enter the bay in August and become very abundant in September and October. They decrease in number during December. During February, 1890, none were seen, but stragglers were taken in March and May, 1889.

At present this fish is of little importance at San Diego.* Very few large ones are taken and those are usually caught while fishing for other fish. The tinkers afford sport to many idlers on the wharves, but otherwise little use is made of them. At Monterey they are abundant during June, and at times bring a high price. They are taken with the gill net at Monterey, a mode of fishing scarcely in use at San Diego.

*Since this was written a cannery was established and many fishermen make it a business to catch mackerel with hook and line off Ballast Point.

Green eggs of August 16 measure 0.66 mm. They have an amber-colored oil globule 0.24 mm. in diameter.

Sarda chilensis (Cuvier & Valenciennes).

J. & G. '80, 27; R. Smith '80; J. & G., '80[a], 456, *id.* 81, 45; *id.* '82, 428; R. Smith '85; E. &. E. '89. Girard, Pacific R. R. Survey, x. 106, 1859 (as *Pelamys lineolata*).

This species is very common off Point Loma. Many more are taken than can be disposed of fresh. It is usually found in schools and apparently migrates with the barracuda. It is probably found here throughout the year, but none were recorded in April or June. It was very abundant from July to December, 1889. Toward the latter and early part of the year the young occasionally enter the bay. On January 4, 1890, a few were taken and one young one on the 30th. On February 28, six were taken; during March of 1890, four small ones were taken on the 1st, while they were abundant and with free flowing milt on the 27th of March, 1889.

Orycnus alalonga (Gmelin).

E. & E., '89.

This species is abundant off the coast in summer. It is never brought into the market.

Gymnosarda pelamys (Linnæus).

E. & E., '90, 8.

This is said to be common off Point Loma, but only on two occasions were any brought into the San Diego market, *i. e.*, on October 31 and December 15, 1889.

Trachurus picturatus (Bowdich).

R. Smith, '85; E. & E., '89.

This species is never abundant at San Diego. The first ones of 1889 arrived on July 3, and while it was sometimes quite common, especially among the catch with hook and line on the wharf, it never reached any economic importance. On January 4, 1890, a few young ones were taken in the bay; later it was not observed. It is found in San Francisco in May, and large ones are sold in September.

Caranx chrysus caballus Günther.

Trachurus boops Girard, Pacific R. R. Survey, x, 108, 1859.

This species is recorded from San Diego by Girard. We have not seen it.

Seriola dorsalis Gill. Yellow tail.

R. Smith, '80; J. & G., '80a, 456; J. & G., '81, 46.

This large species is quite abundant off Point Loma, but it rarely enters the bay. It is taken by the barracuda boats. It is not very highly esteemed and never brings over 25 cents apiece. It arrived

in 1889, on April 30, and was found throughout the rest of the year. It was quite abundant on Cortes Banks in August, but no use was made of it except as bait. It migrates southward towards winter and decreases in abundance during November. Stragglers like those of the Spanish mackerel enter the bay late in the season. During December, 1889, it was taken on the following dates: 11th, 16th, 19th, 30th. On the 11th, one was taken in the bay; on the 19th, one was taken off Point Loma, and on the 30th, three were taken. During January and February of 1890 none were seen.

Jordan & Gilbert (1881) state that it spawns in July and August.

STROMATEIDÆ.

Stromateus simillimus (Ayres). Pompano.

R. Smith, '80; J. & G. '80a, 456; *id.*, '81, 46; *id.*, '82, 451; R. Smith, '85, July.

Though common at times this fish is not of such importance here as at San Francisco. In San Francisco it brings from 25 cents to $1.25 per pound. In San Diego it sells at 3 cents.

It arrives at San Diego in May, the first ones observed being on May 16. Another one was taken on June 1. This was a male with ripe milt. During August and September it was quite abundant, being chiefly taken with hook and line off wharves. It is not caught outside. During December only a few young ones were caught. During January of 1890 a few more and on February 21 one more young one was taken.

SERRANIDÆ.

Paralabrax clathratus (Girard). Kelp Bass; Sand Bass.

Girard. Pacific R. R. Survey, Vol. x, 35, 1859; Steind., Ichthyol. Beitr., III, 1, 1875; J. & G., '80, 27; R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 47; *id.*, '82, 535; R. Smith, '85, July; E. & E., '89.

The young of this species are abundant in the bay. The old are rarely, if ever, seen in the bay. They are taken in 15 to 50 fathoms of water with Rock Cod. It is not so frequently brought into the markets as the other species of the genus.

Paralabrax maculofasciatus (Steindachner). Rock Bass.

Steindachner, Ichthyol. Beitr., III, 1, 1875; J. & G., '80, 27; R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 416; *id.*, '82, 536; R. Smith, '85, July; Am. Nat., Feb. 1891, figures.

This species is a permanent resident in the bay. It was especially abundant during fall and early winter. The eggs of this species, like those of the next, are pelagic, colorless, transparent, 0.75 to 0.81 millimeter in diameter. There is in each case a single colorless globule.

The eggs of *Paralabrax maculofasciatus* were first observed on June 25. They were next observed on August 10, and were occasionally

found throughout the remainder of August. The blastopore closes in about eighteen hours, and the embryo is freed in about thirty-eight hours. On hatching the embryo measures 1.7 millimeters, the yolk sack 0.65 millimeter.

At the time of the closing of the blastopore a few color cells are scattered over the yolk near the oil globule; a yellow pigment is pretty evenly distributed along the sides of the embryo. This yellow pigment shortly becomes collected in well-defined areas along either side of the embryo, and at the time of hatching there is a mass of cells at the snout, one behind each eye, one behind each auditory capsule, four just behind the yolk sac, and two or three on the anterior half of the tail. A few black cells are scattered along the back. These cells soon become dendritic to such an extent that there is little similarity between the larva at hatching and twelve hours afterward.

At the time of hatching the larva measures 1.7 millimeters, the yolk sac 0.65 millimeter. The oil globule, as in *nebulifer* and *atrarius*, is embedded in the anterior end of the yolk.

The color cells in the case of *P. maculofasciatus* do not, as in the cases of *Sciæna* and *Hypsopsetta*, all become free. Sketches of this species were made a few moments apart (see Am. Nat., February, 1891). The color cells are first noted when the gastrula covers about two-thirds of the yolk. At this time no pigment is deposited in them and only those which are freed from the embryonic shield can be distinguished. Very few of the cells ever become freed from the shield and all those that are freed are destined for the oil globule. The great majority of color cells remain attached to the margins of the shield. They migrate, however, as is seen in their shortly aggregating in definite regions of the body.

Paralabrax nebulifer (Girard). Rock Bass.

Steindachner, Ichthyol. Beitr., III, 1, 1875; R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 47; *id.*, '83, 536; R. Smith, '85, July; E. Am. Nat., Feb. 1891, figures.

This species is found in the bay with the preceding.

But two eggs of this species were observed, one on June 25 and the other on August 26. In this species only black pigment cells are formed. The embryo is freed from the membrane in thirty-six hours and measures 22 millimeters; the yolk sack measures 1.3 millimeters. On the body the black cells are confined to the dorsal surface, while on the tail they are more uniformly distributed. The oil globule is situated at the anterior end of the yolk.

Stereolepis gigas Ayres. Black Sea Bass.

J. & G., '80, 27; R. Smith, '80; J. & G., '80, 456; *id.*, '81, 47; *id.*, '82, 531; R. Smith, '85, July; E. & E., '89.

I am not certain whether this species is migratory or not, but am inclined to believe it is. It is not very abundant, but a number can always be taken, at least in certain seasons, by using the proper gear

and bait. They seem always to accompany the white fish and these fish are consequently used as bait. Several were brought into the market, but the dates were not kept. In July several were taken on Cortes Banks while others were taken near Point Loma in October and November, 1889.

SPARIDÆ.

Xenistius californiensis (Steindachner). Raspers.

Steind. Ichthyol. Beitr. III, 3, 1875; E. & E. '89a.

Until recently this fish was very rare. On May 20 one was taken in a seine, and the fishermen stated that it was occasionally found. During August and September large numbers were caught with hook and line. The last one was taken November 9.

Anisotremus davidsoni (Steindachner).

Steind. Icthyol. Beitr. III, 6, 1875; R. Smith '80; J. & G. '80a, 456; *id.* '81, 47; *id.*, '82, 531; R. Smith '85, June.

This species is found in the bay from April to November. None were observed between November 9, 1889, and March, 1890. The first one of 1889 arrived April 20. It is quite common during its season, although few records were made of it. It is a food fish of some value and is caught in seines and with hook and line.

Girella nigricans (Ayres).

J. & G. '80, 28; R. Smith '80: J. & G. '80a, 456; *id.*, '81, 47; *id.*, '82, 560; R. Smith '85, June; E. & E. '89.

This is a permanent resident among the rocks of the ocean shore, and just within the entrance of the bay. It is rarely taken by the seiners on account of the impossibility to draw the net where they reside. On April 17 a number of ripe males were taken.

Cæsiosoma californiense (Steindachner).

Steind. Ichthyol. Beitr. III, 19, 1875; R. Smith '80; J. & G. '80, 456; *id.*, '81, 47; *id.* '82, 562; R. Smith, '85, June.

This species is very probably a permanent resident. It is very rare. Those seen were taken among the piles of the ferryslips and wharves, and if this should be their habitual abiding place the fact that they are not more frequently taken would be explained. It is of no economic importance. On May 3d a male with ripe milt was procured.

SCIÆNIDÆ.

Roncador stearnsi (Steindachner).

Steind. Ichthyol. Beitr. III, 22, 1875; J. & G. '80, 28; R. Smith '80; J. & G. '80a, 456; *id.*, '81, 49; *id.*, '82, 572; R. Smith '85, June.

This is an important food fish which is only occasionally absent from the bay. During January, 1889, none were taken in the bay,

while on December 18th, 1889, 400 pounds were caught with one haul of the seine, and on January 10, 1890, they were again abundant. During the summer they do not go in schools. Those caught on December 18, 1890, were said to have been burrowing with their blunt snouts for a small mollusk (*Empidonax*) on which they largely subsist.

Sciæna saturna (Girard). The Croaker.

Girard, Pacific R. R. Survey x, 98, 1859; J. & G. '80, 28; R. Smith '80; J. & G. '80a, 456; *id.*, '81, 49; *id.*, '82, 572; R. Smith, June, '85.

This is an important food fish. It is migratory. The males, which are then quite black, enter the bay as early as January (28 and 29, 1890), and by the middle of February and March it is common. The last one was observed September 24.

Ripe males were seen March 27 and ripe females the two months following. Eggs were skimmed from May 2. Evenings while skimming over the breeding grounds their frog-like croaking could be heard on all sides.

The eggs of this species are remarkably like those of a flounder (*Hypsopsetta*) and it is only after a time that they can certainly be told apart. It is not unlikely that several species of pelagic eggs have been confounded with this one, as eggs supposed to be these were taken from May to the middle of August. If this should be the case they probably belong to the other species of this family, the eggs of which have not yet been described.

The eggs are transparent, 0.78 millimeter in diameter, and have from two to eight oil-globules, which, in late stages, are united into one. The eggs can best be distinguished from those of *Hypsopsetta* by the method of the formation of the chromatophores. These are formed along the entire embryonic ring in this species and appear quite early.

The time required for hatching, if indeed all the eggs referred to this species belong to it, varies greatly with the temperature, the longest time being forty-eight hours, the shortest eighteen. In those hatching earlier the yolk is not as much reduced as in the others, and the tail is not quite as long.

The young of this species were figured in the American Naturalist for February, 1891.

Genyonemus lineatus (Ayres).

E. & E., '89a.

This species entered the bay in large numbers in December (27), 1890. During the latter part of January ripe females were obtained. None were seen after February 3. The eggs are pelagic 0.71 millimeters in diameter and have an oil globule 0.18 millimeters in diameter. It is caught with the seine and with hook and line.

Umbrina roncador Jordan & Gilbert.

R. Smith, '80 (as *U. xanti*); J. and G., '80a, 456; *id.*, '81, 48; *id.*, '82, 576; R. Smith, '85, June.

This species was abundant in the bay at various times between May (25) and January. It is taken with the seine.

Menticirrhus undulatus (Girard).

Girard Pacific R. R. Survey x, 101, 1859; Steind, Ichthyol. Beitr. III, 21, 1875; J. & G., '80, 28 as (*M. elongatus*); R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 48; *id.*, '82, 578; R. Smith, '85, June.

Migratory. This species was, with the preceding, abundant at times between July and January. On January 9, 1890, one was taken in the bay; on February 11 another. On February 19, 1890, a boatload of this species and of *Cynoscion parvipinne* was brought by Chinese fishermen from lower California.

Cynoscion nobile (Ayres).

R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 48; *id.*, '82, 579; R. Smith, '85, June.

Migratory. This species entered San Diego Bay in April (26) and remained till November. Those in the bay are all young specimens less than 600 millimeters long. They are taken with the seine and with hook and line. Larger ones, reaching 1.2 meters, are occasionally (November 7, 1889,) taken off Point Loma. Either this species or the next were reported to have ascended a stream produced by the waste water of the Sweetwater dam. It was brought to the San Francisco market May 2, 1890.

Cynoscion parvipinne Ayres.

J. & G., '80, 28 as (*C. magdalenæ*); R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 48; *id.*, '82, 580; R. Smith, '85, June.

This species probably enters the bay with the preceding species, being also migratory. The first individual was seen March 21, 1889, the last December 30.

Seriphus politus Ayres.

R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 48; *id.*, '82, 582; R. Smith, '85, June.

Migratory. This species is said by Jordan to be abundant during summer about Santa Cruz. It does not reach San Diego till September (10, 1889), and is abundant at least till March. The time of its disappearance has not been determined, as it was not seen in the spring of 1889.

GERRIDÆ.

Gerres cinereus Walbaum.

R. S. E., Am. Nat., 1891, 156.

One specimen of this species was taken by Mr. Medina during the summer of 1890. Mr. Medina preserved the specimen for me, but the exact date was not kept.

EMBIOTOCIDÆ.

The members of this family are probably all permanent residents. From their abundance they are important fishes. Those taken outside are, as a rule, of much better flavor than those taken in the bay. Some of the species habitually live in the surf of the ocean beaches, while others habitually live in the bay.

Since their discovery these fishes have been of great interest on account of their most pronounced viviparity. Several papers have dealt especially with the embryology, but no one has hitherto been able to study the early stages.

The early stages of all of them occur in December or thereabout. The older individuals are with ripe eggs earlier in the season than the younger, so that in species like *Amphistichus argenteus* where there are three distinct sizes of individuals, there are three distinct periods when the eggs mature, with an interval of about a month between two of these periods.

The embryology of the members of this family will be treated in a separate paper.

Owing to the fact that these fishes are permanent residents, few notes on their occurrence were made. Some are always found in the market, and many are thrown away when caught.

Abeona minima (Gibbons.)

J. & G., '80, 28; R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 51; *id.*, '82, 587; R. Smith, '85, June.

This species is very abundant in the eel grass near tide marks in the bay. The females are much larger than the males but none reach a size to warrant bringing them to the market.

The eggs of this species can be procured in December, January, and February. With those of *cymatogaster* they are the smallest fish eggs known, the yolk being scarcely developed.

Brachyistius frenatus Gill.

R. Smith, '85, June.

Very rare, only a single specimen seen (May 29, 1890).

Cymatogaster aggregatus Gibbons. Shiner.

J. & G., '80, 28; R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 51; *id.*, '82, 590; R. Smith, '85, June; Eigenmann, Am. Nat. Mch. 89, 107; E. & E., West Am. Scientist, June, 1889.

This is even more abundant than *Abeona minima*. It is found with it, but also along the beaches of the bay and about the piles of wharves, especially during the breeding season. It is rarely brought into the market, and then only when mixed with other species.

Hyperprosopon argenteum Gibbons. Wall-eyed Perch.

J. & G., '80, 28 (as *Hyperprosopon arcuatum*); R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 50; *id.*, '82, 591; R. Smith, '85, June.

Very abundant in the bay; it is caught with seines and frequently brought to the market; but little esteemed, and is of little economic importance.

Holconotus rhodoterus Agassiz.

Girard, Pacific R. R. Survey, X, 195, 1859; E. & E., 90, 9.

Only a single specimen taken. It was found with *A. argenteus* in the ocean surf, January 10, 1890.

Amphistichus argenteus Agassiz. Surf Perch.

J. & G., '80, 28; R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 50; *id.*, '82, 593; R. Smith, '85, June.

This species is one of the most abundant. It never enters the bay, being always found in the surf of the ocean beaches. It is the best flavored of the perches but is rarely caught for its own sake. When the smelt (*Atherinopsis californiensis*) arrives and before it enters the bay the fishermen seine for it on the ocean beaches and frequently catch quantities of this species. At other times of the year it is not found in the markets. Those caught could readily be divided into three grades, according to their size. The largest ones contained developing eggs the middle of November, the next in size the middle of December and the third were not yet mature when they stopped coming into the market the 7th of January.

This species is frequently caught with hook and line in the surf; the great bulk of those so caught are males. They feed on the crustaceans which burrow in the sandy beaches and follow the breakers to procure their food.

This is the most prolific of the species found at San Diego. It contains as many as fifty young, while the other species would scarcely average more than twelve.

Hypsurus caryi (Agassiz).

R. Smith, '80.

This species has not been observed by me.

Embiotoca jacksoni Agassiz. Black or Blue Perch.

Girard, Pacific R. R. Survey, X, 171 and 173, 1859 (as *E. cassidii* and *E. webbi*); J. & G., '80, 28; R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 50; *id.*, '82, 595; R. Smith, '85, June.

Very common in the bay. Not very highly esteemed, and of no great economic importance.

Phanerodon laterale Agassiz.

Girard, Pacific R. R. Survey, X, 176, 1859 (as *E. ornata*); R. Smith, '85, June.

Very rare.

Phanerodon atripes Jordan & Gilbert.

E. & E., 89a.

Only one specimen known; from the Cortes Banks. It is the commonest species of Monterey Bay but does not reappear on the coast to the south, between Monterey and the Cortes Banks.

Phanerodon orthonotus E. & E.*

E. & E., '89.

Only one specimen known; from the Cortes Banks.

Phanerodon furcatum Girard.

J. & G., '80, 28; R. Smith, '80; J. & G., '80a, 456; *id.*, '81, 50; *id.*, '82, 596; R. Smith, '85, June.

One of the commonest species in the bay and not rare on rocky places of the ocean coast. On account of its exterior appearance it is more highly prized than *E. jacksoni*, though scarcely a better fish. It is almost daily brought into the market, especially when flounders, the various bass and the various croakers are scarce.

Rhacochilus toxotes Agassiz.

E. & E., '89a.

Rare, or else living in places where little fishing is done. It was noticed once during February.

Damalichthys argyrosomus Girard.

E. & E. '90, 9.

This species was moderately abundant between November and March. It was not seen during summer.

LABRIDÆ.

Trochocopus pulcher (Ayres).

J. & G., '80, 29; R. Smith, '80; J. & G., '80a, 455; *id.*, '81, 51; *id.*, '82, 602; R. Smith, '85, June; E. & E., '89.

This species is very abundant in all rocky places of moderate depth outside the bay. It never enters the bay. Large quantities are sometimes dried by the Chinese but otherwise it is of little importance. It is a rather coarse fish and on account of its uncouth appearance it is not in general favor.

It is abundant on Cortes Banks, and a quantity was salted by the Azalene.

Platyglossus semicinctus (Ayres).

Steind. Ichthyol. Beitr., V., 151, 1876; R. Smith, '85, June; E. & E., '89.

Not common, and but rarely entering the bay. It was noticed but once or twice in the market.

Ripe eggs were obtained in mid August. They measure .66–.70 millimeters. They are transparent, and possess a single oil globule .14–.16 millimeters in diameter.

* This species is in all probability identical with *P. atripes*.

Pseudojulis modestus (Girard).

Girard, Pacific R. R. Survey, X, 164, 1859; R. Smith, '85, June; E. & E., '89.

Common in the kelp and generally outside. It rarely, if ever, enters the bay, and is rarely brought to the market. It is quite abundant at Cortes Banks, and is not an unimportant item of the food of larger fishes.

POMACENTRIDÆ.

Pomacentrus rubicundus (Girard).

Girard, Pacific R. R. Survey, X, 161, 1859; R. Smith, '80; J. & G., '80 a, 455; *id.*, '81, 52; R. Smith, Proc., U. S. Nat. Mus., 1882, 652; J. & G., '82, 610; R. Smith, '85, June.

Common at rocky ocean beaches. The adult of this species has never been seen in the bay. A few young, in which the bright blue had almost all given place to the bright red of the adult, were taken in the bay and held at fabulous prices. It is not used as food, the only place where they abound being reserved, so visitors may enjoy seeing them. Rosa Smith records it (unpublished notes) as being caught in lobster pots.

Chromis punctipinnis Cooper.

R. Smith, '80; J. & G., '80a, 455; *id.*, '81, 52; *id.*, '82, 611; R. Smith, '85, June, E. & E., '89a.

Seen but once, the single specimen taken from the stomach of a rock cod caught on Cortes Banks.

EPHIPPIDÆ.

Chætodipterus faber zonatus (Girard).

Not seen by us nor at any time by Rosa Smith.

LATILIDÆ.

Caulolatilus princeps (Jenyns). The Whitefish.

J. & G., '80, 27; R. Smith, '80 (as *C. anomalus*); J. & G., 80a, 455; *id.*, '81, 53; *id.*, '82, 625; R. Smith, '85, June; E & E., '89.

This is probably a permanent resident. The fishermen say that winter is their principal season, though the catch during the past winter was light. It was common on Cortes banks during July and August, and during the first half of October off Point Loma. But few were taken in September and December, but during November and January it was again abundant. During April, May, and June I did not notice it, a fact which does not prove its absence, however.

The majority of those caught are sold fresh. The Azalene salted many. For some reason the flesh of this fish is frequently bitter and disagreeable and possesses a peculiar smell when quite fresh. The fishermen attribute it to the breaking of the gall-bladder in cleaning. I have proved that this is not the case.

GOBIIDÆ.

The members of this family are all small and not at present used for food by man in the San Diego region. They play a most important role in fish economy, since, next to the species of *Stolephorus*, they probably furnish the largest share of food for the fishes of the bay. The species have been discussed in Zoe for May, 1890.

Gobius nicholsi Bean.

I have not taken this species. Dr. Gilbert informs me that it is quite abundant in deep water off Point Loma.

Lepidogobius gilberti E. & E.

E. & E., Proc. U. S. Nat. Mus., 1888, 464; Eigenmann, Zoe, May, 1890.

This species is less abundant than the preceding, with which it is sometimes associated. Most of the specimens known were dug out of the sand near La Playa. It spawns early in May.

Lepidogobius y-cauda (J. & E.). (Plate XIV, Fig. 6.)

E. & E., '90, 11; Eigenmann, Zoe, May, 1890.

This species is found in tide pools nearer low-water mark than *Clevelandia*. It is not very abundant.

Clevelandia longipinnis (Steindachner). (Plate XIV, Fig. 5.)

E. & E., '90, 10; Eigenmann, Zoe, May, 1890.

This is the most abundant fish in the bay. It is found in great abundance in all the little pools left on mud flats by the receding tide. Like most other species of this family found about San Diego it hides in holes in the mud or sand as soon as disturbed.

Gillichthys mirabilis Cooper. (Plate XV, Fig. 12.)

Gilbert, Proc. U. S. Nat. Mus. J. & G., '80, 25; R. Smith, '80; J. & G., '80a, 455; *id.*, '81, 53; *id.*, '82, 636; R. Smith, '85, June; E. & E., Proc. U. S. Nat. Mus., 1888, 463 (as *G. townsendi*); Zoe, May, 1890.

Very abundant in the sloughs of mud flats. During summer they bite voraciously at all bait offered, especially during the incoming tide. Toward their spawning season they retire to their respective crab holes, and no morsel, be it ever so tempting, will lure them forth. They first spawn at San Diego about the end of March. The young are very active, jumping several times their own length if left dry in a watch crystal. It is the largest of the gobies found about San Diego.

Typhlogobius californiensis Steindachner. (Plates XV and XVIII.)

Steind. Ichthyol. Beitr., VIII, 23, 1879; R. Smith, Proc. U. S. Nat. Mus., 1881, 19, as *Othonops cos;* J. & G., '81, 53; *id.*, '82, 639; R. Smith, '85, June; E. & E., West. Am. Scientist, June, 1889; Eigenmann, Zoe, May, 1890.

Abundant at Point Loma under rocks between tide marks.

The most remarkable of the gobies is undoubtedly the blind one inhab-

iting the crab holes under rocks at Point Loma. It has been found nowhere else about San Diego, but has been taken at Ensenada. Its habitat is, as far as known, quite limited. In its pink color and general appearance it much resembles the blind fishes inhabiting the caves of southern Indiana. Its peculiarities are doubtless due to its habits. The entire bay region is inhabited by a carideoid crustacean which burrows in the mud. It, like the blind fish, is pink in color. Its holes in the bay are frequented by *Clevelandia*, etc., while at the base of Point Loma, where the waves sometimes dash with great force, the blind fish is its associate.

On rough days few fish are seen, though ever so many stones are overturned, a task rendered somewhat laborious and bad for the fingers by the numerous worn tubes, etc., attached to the rocks. On mild days, on the contrary, with very low tides, quantities are found, and almost invariably in company with one of the crustaceans mentioned above. Sometimes the fishes live quite out of water on the damp gravel and sand under a rock, but more frequently small pools of water fill all the depressions under the rocks, and the fishes swim rapidly away in their attempt to hide in the crab holes, several of which always branch from the cavity in which the rock has lain.

In the bay the gobies habitually live out of the holes, into which they descend only when they are frightened, while at Point Loma this species never leaves its subterranean abode, and to this fact we must attribute its present condition.

How long these fishes have lived after their present fashion it would be hard to conjecture. The period which would produce such decided structural changes can not be a brief one. The scales have entirely disappeared, the color has been reduced, the spinous dorsal has been greatly reduced; not only have the eyes become stunted, but the whole frontal region of the skull, and the optic nerves have been profoundly changed.

The skin, and especially that of the head, has become highly sensitized. The skin of the snout is variously folded and puckered, and well supplied with nerves; the nares are situated at the end of a fleshy protuberance which projects well forward, just over the mouth. At the chin are various short tentacles and a row of papillæ, which very probably bear sensory hairs similar to those represented in Figs. 15 and 16 (plate VIII), extends along each ramus of the lower jaw, and along the margin of the lower limb of the preopercle. The eye is, however, the part most seriously affected. In the young, Fig. 7, it is quite evident, and is apparently functional. Objects thrust in front of them are always perceived, but the field of vision is quite limited. With age the skin over the eyes thickens, and the eyes are scarcely evident externally. As far as I could determine they do not see at this time, and certainly detect their food chiefly, if not altogether, by the sense of touch. A hungry individual will swim over meats, fish or a mussel,

etc., intended for its food without perceiving it by sight or smell, but as soon as the food comes in contact with any portion of the skin, especially of the head region, the sluggish movements are instantly transformed, and a stroke of the fins brings the mouth immediately in position for operations.

I have not been able to raise the fishes from the egg. The youngest individual ever seen is represented in Fig. 7.* In this specimen the membranes of the fins were thin, the color cells were well formed and arranged not unlike those of the young *Gillichthys*, Fig. 12. Its movements were similar to those of the other gobies, and not at all sluggish like those of the adult. The favorite position is a standing or sitting one with the broad pectorals extending out at right angles to the body. In this position the fish can, with a sudden stroke of its pectorals, move quickly and rapidly. In the old the fins are thick and smaller in proportion, and all the vivacity seems to have disappeared. The color has degenerated, or at least not developed in proportion to the growth of the fish.

The minute structure of the eye was not examined. It will be described in another paper. The eye and optic nerve have been isolated by treatment with 20 per cent nitric acid, and by simple dissection of alcoholic specimens. The lens is large in proportion to the size of the eye, which does not materially differ in size in the smallest and largest specimens examined. The optic nerve is very slender and long as compared with that of any of the other gobies.

All the gobies are tenacious of life, especially the blind one. Several of the latter have been kept in a half-gallon jar for several weeks without change of water, and others have been kept several months in confinement in my laboratory. When the water becomes somewhat stale they frequently rise to the surface and use the surface of the water as a plane to which they attach themselves by means of their ventrals.

It was my intention to study the development of the eyes, etc., of this fish, and with this end in view I kept many specimens alive and made frequent trips to Point Loma to procure fresh individuals in order that too long confinement might not have impaired the reproductive function. They spawn in the latter part of May and June, but I have not found the eggs in nature. Those deposited in confinement would not develop, and attempts at artificial fertilization of freshly-caught individuals were not successful. An absence from San Diego prevented

* During the summer of 1891 Mr. L. C. Bragg, of Coronado, found the eggs attached to the lower surfaces of the rocks under which the fish live. He kindly gave me several specimens from which the drawings of plate A, xviii were made. The zona is seen in nature to expand enormously and become club-shaped. In this chamber the young are able to live long beyond the ordinary hatching period of fishes. The eggs are attached to the rocks in a single layer by the network of threads surrounding the micropyle. The eyes develop normally, and those of Fig. 4 differ in no way from the eyes of other fish embryos. This offers a most striking example of degeneration. The minute structure of these larval eyes will be described by one of my students.

me from visiting their habitat during July, and in August the tides were not favorable.

The earliest date at which I procured young was October 25; the smallest caught at that time is represented in Fig. 7.

Though I did not secure developing eggs, those procured enable me to describe the remarkable membranes of the egg, which are probably similar in many other gobies.

The covering of the ovarian egg consists first of a finely striate membrane, the zona radiata of all telostean eggs. Exterior to this is a network of threads with the meshes coarsest at the entodermic pole, and forming almost a continuous membrane at the ectodermic pole, Figs. 4 and 5. The eggs were examined from the surface only, and I am not able to say how intimate the connection between the threads and the zona is in the ovary. When the eggs are deposited the meshwork of threads is stripped off the egg and remains attached to the zona radiata around the micropyle, Figs. 1, 2, 3, and 5. In the eggs deposited naturally by the females in confinement the threads had been wound together to form a cord at the micropylar end of the egg, Fig. 1. The cords of many of these eggs were attached to each other, and the eggs thus came to be laid in bunches like those of grapes. The bunches of eggs resemble so closely those of the crustacean with which this fish is associated, and which spawns at the same time, that the idea of a highly specialized mimicry at once suggests itself. The similarity between the eggs is heightened by the fact that they are both bright yellow. In females with ripe eggs they can frequently be seen forming a yellow band along the flanks.

The yellow of the blind-fish egg is entirely confined to the yolk which contains many oil globules. The granular protoplasm is opaque.

CHIRIDÆ.

Ophiodon elongatus Girard.

E. & E., Proc. U. S. Nat. Mus., 1888, 465; E. & E. '89a.

Not very abundant, but probably a permanent resident. It is found in deep water outside the bay only. The young, so abundant in San Francisco Bay, were not seen.

Zaniolepis frenatus E. & E.

E. & E. '89a.

One specimen about 160 millimeters long was taken from the stomach of a rock cod on Cortes Banks.

SCORPÆNIDÆ.

We have been able to largely increase the number of species of this family, previously recorded from San Diego, and to make pretty extensive observations on the seasons of maturity of the various species.

Sebastodes pancispinis (Ayres).

E. & E. '89.

Moderately abundant throughout the year, reaching a large size. It is one of the more important of the species. With young during December, January, and February.

Sebastodes flavidus Ayres.

J. & G. '80a, 455; *id.* '81, 55; *id.* '82, 657; R. Smith '85, 46; E. & E. '89.

We have evidently confounded two species under this head. It is not very abundant. With young in January.

Sebastodes serranoides E. & E.

E. & E. '89 (in part as *S. flavidus*); E. & E., Proc. Cal. Acad. Sci., Ser. II, Vol. III, 36, 1890.

This species was erroneously recorded by us from Cortes Banks as *S. flavidus*. It is occasionally brought into the market.

Sebastodes goodei E. & E.

E. & E. '90, 12.

This species seems to be abundant in deep water (about 100 fathoms). The largest specimens observed were 550 millimeters. It was taken in January (9 and 29), February (14), and March (4). It is one of the most important of the rock cods in the San Francisco market.

Sebastodes rufus E. & E.

E. & E. '90, 13.

This species was observed in November (14, 1889) and December (2 and 10, 1889).

Sebastodes ovalis Ayres.

E. & E. '89; E. & E. '89a.

Frequently brought to the market, but not in large numbers. It was taken on Cortes Banks. Among many specimens brought into the market October 15 two were gravid. The eggs in both were in nearly the same stage of development. Some of the embryos were still alive, the heart beating. The eggs are more spherical than in *rubrovinctus* of the same stage and there is as yet no pigment formed anywhere. There is usually but a single large oil sphere, but not rarely there are two or three.

Sebastodes mystinus Jordan & Gilbert.

J. & G. '80a, 455; *id.* '81, 56; *id.* '82, 659; R. Smith, '85, June; E. & E. '89 (as *S. melanops*); E. & E. '89a.

Abundant on Cortes Banks and not infrequently brought into the market.

Sebastodes proriger Jordan & Gilbert.

E. & E. '90, 15.

Not very abundant, but much larger in size than farther north. Jordan & Gilbert state that it reaches a length of 250 millimeters. The largest observed by us measured 600 millimeters.

Sebastodes atrovirens Jordan & Gilbert.

J. & G. '80, 27; R. Smith '80; J. & G. '80a, 455; *id.* '81, 56; *id.* '82, 661; R. Smith '85, June.

Only a single specimen noticed (August 23).

Sebastodes melanostomus E. & E.

E. & E. '90, 17.

A single specimen, about 55 millimeters long, taken November 14, 1889.

Sebastodes pinniger (Gill).

E. & E. '90, 16.

Much less abundant than farther north. It is found in deep water (100 fathoms). It was brought to the market on the following dates: December 3, 5, and 11; January 13 and 21; February 14; March 1.

Sebastodes miniatus Jordan & Gilbert.

R. Smith, '85, June; E. & E., '89.

This is the most abundant and by far the most important of the Rock Cods. It surpasses in abundance all the rest combined and large numbers are daily brought into the market. The half-grown, those about 10 inches long, abound in the kelp in November. These have black-margined fins. The old ones live in deeper water.

They are with young in December and January and during that time the bottoms of the Rock Cod boats are covered with the eggs and young pressed out by the superimposed fish.

It is abundant on Cortes Banks.

Sebastodes ruber (Ayres). (Plate xvi, figs. 4–7.)

E. & E., '89; E. & E., '89a.

Not abundant, but frequently brought to market.

With young on Cortes Banks in July and August. The oil globule is small and the larva quite long at the time of hatching. There is a series of pigment spots along the lower part of the tail and over the abdomen.

Sebastodes rosaceus (Girard).

Girard, Pacific R. R. Survey x. 78, 1859. E. & E., '89; E. & E., '89a.

Quite abundant, but usually either used for bait or thrown overboard on account of its small size. For the same reason that it is least prized in San Diego it is most preferred in San Francisco, where small Rock Cod always have a readier market than large.

Sebastodes constellatus Jordan & Gilbert.

R. Smith, '85, June; E. & E., '89.

Abundant, reaching a larger size than *rosaceus*. The ovaries of some were empty on November 12.

Sebastodes æreus E. & E.

E. & E., '90, 20.

Rare. This species was observed on November 7 and January 9 and 24. Type U. S. Nat. Mus., No. (41868.)

Sebastodes chlorostictus Jordan & Gilbert.

E. & E., Proc. U. S. Nat. Mus., 1888, 465; E. & E., '89.

Abundant. In the markets almost daily with *S. miniatus*. This species is with young in February or March. Abundant on Cortes Banks.

Sebastodes eos E. & E.

E. & E., '90, 18.

Very similar to *chlorostictus*, but less abundant. It was observed November 14, December 4 and 10, abundant on the latter date, and on February 21.

Sebastodes gilli R. Eigenmann.

R. S. E., Am. Nat.

Three specimens of this species were taken within a few days of each other about the middle of November, 1890. The types of these species are in the British Museum.

Sebastodes elongatus Jordan & Gilbert.

E. & E., '89; E. & E., '89a.

Quite abundant, but, with *rosaceus* usually discarded. It is usually present in all catches of Rock Cod made in shallow (50 fathoms or less) water. At San Francisco it has a ready market.

Sebastodes levis E. & E.

E. & E., '89; E. & E., '89a.

This is the largest of the Rock Cod, reaching a weight of 29 pounds. It is almost daily brought into the market. Seventeen individuals is the largest catch reported by a single boat in a day. It is common on Cortes Banks. Types U. S. Nat. Mus., No. (41904.)

With young in January and February.

This species is so closely related to *S. rubrorinctus* that at one time I supposed the two species identical. I have been able to compare specimens of the two species of the same size (about 490 mm. long) with the following results:

a. Eye very large, orbit $\frac{3}{4}$ in snout, $3\frac{1}{2}$ in head; interorbital equal to snout, concave; preocular spines short, bulging outward; supraocular short, heavy, blunt; the two upper preopercular spines directed backward, the three lower downward; preorpital spines sharp, the posterior tricuspid; gill rakers long, nearly equal to maxillary width, 9+21; membranes of first five dorsal spines meeting the succeeding spine below its middle. Head broad and short, its width between upper angle of preopercle $2\frac{1}{3}$ in its length, $2\frac{5}{7}$ in the length, depth about equal to the length of the head; bases and anterior portion of spinous dorsal membranes scaled; peritoneum gray. Axil red ..... *rubrorinctus.*

aa. Eye small, orbit $1\frac{1}{2}$ in snout, $4\frac{3}{4}$ in head; interorbital $1\frac{3}{4}$ in snout, convex or flattish; preopercular spine slender; supraocular slender, sometimes continued to the postocular without spine; the four upper preopercular spines directed backward, the lowest one downward; preorpital crenulate, without spines; gill rakers short, less than one-third of maxillary width, 8+21; membranes of first seven dorsal spines meeting the succeeding spine below the middle; the membranes much more deeply incised than in *rubrovinctus*. Head compressed, its width between upper angles of preopercles $2\frac{1}{2}$ to 3 in its length, which is about $2\frac{1}{7}$ in the length; depth; membranes of spinous dorsal naked; peritoneum white.

Pink; axil and region above it dusky; four indistinct dusky vertical bars less than half as wide as eye; one below first dorsal spine, one below the sixth, one between tenth and eleventh, and one below middle of soft dorsal; a few indistinct dark spots on upper part of opercular membrane ..... *levis*

Sebastodes rubrovinctus Jordan & Gilbert.

E. & E., '89; E. & E., '89a.

Most nearly related to *S. levis*. Not frequently brought into the market and never more than two seen on any one day. It is one of the rarer species and has not. previous to this year, been recorded from San Diego. It has proved an excellent object for determining the probable duration of gestation. From the individuals brought to my notice it would seem that the eggs are ripe in all individuals at nearly the same time. One individual of September 14 had ripe eggs which were free or only mechanically inclosed in the follicle. On September 16 the first developing eggs were observed, the gastrula covering about one-third of the yolk. No more individuals were seen till October 9, when there were two females, one of which had given birth to all its young, in the other the embryos were nearly ready to hatch. On October 11 another female was observed with young of about the same size as those of October 9. The time required to hatch eggs of *rubrovinctus* is, therefore, not far from a month.

The ripe egg is spherical, about 0.9 millimeter in diameter, with one large and several smaller bright, greenish-yellow oil globules the largest measuring 0.32 millimeter in diameter. It is surrounded by a thin membrane. As the embryo nears hatching its tail is brought forward below and curled over the head. The ovum thus assumes a compressed ovate shape, the two larger diameters measuring 1 and 1.3 millimeters, respectively. The eyes are slightly pigmented and there are a few minute pigment cells along the posterior intestinal tract. The tail is entirely free from pigment. The oil globules have united into one, which lies near the middle of the lower surface of the yolk. It was noticed that those eggs most nearly associated with the follicles were slightly further along in their development.

The larvæ are retained some time after hatching. An individual of October 28 contained larvæ 5 millimeters long. The striking feature at this stage is the prolonged lower jaw, which resembles that of the adult *Sebastodes paucispinis* Ayres. A series of black pigment spots along the lower edge of the tail; a few pigment spots on dorsal surface of

head. Sides of abdomen more densely pigmented; *pectorals* with many black pigment cells.

The ovaries are two large sacs, from the dorsal walls of which the oviferous tissues are suspended. Shortly after giving birth to its young the oviducts shrink and the ovaries occupy but a small space. It was stated above that the eggs are freed from the follicle before they are fertilized. It must be borne in mind, however, that this species lives at a considerable depth of water and that many of the tissues are distorted when the fish is brought to the surface and the great pressure of water is removed. To this cause is perhaps to be ascribed the fact that the eggs readily flow from the body with slight pressure at any time during gestation.

Sebastodes auriculatus (Girard). (Plate xvi, figs. 1–3.)

R. Smith, '85, June.

This species is common in shoal water with the young of *S. miniatus*. It does not enter the bay as it does at San Francisco, and little use is made of it, on account of its small size. It is a valuable fish and will doubtless be utilized in the near future. The egg possesses a very large yellow oil sphere and the larvæ are not pigmented at hatching.

Sebastodes rastrelliger Jordan & Gilbert.

Only a single individual observed, on August 23.

Sebastodes vexillaris Jordan & Gilbert.

J. & G., '80a, 455; *id.*, '81, 58; *id.*, '82, 672; R. Smith, '85, June; E. & E., Proc. U. S. Nat. Mus., 1888, 465; E. & E., '89 (as *S. carnatus*).

Next to *S. miniatus* this is probably the most abundant of the Rock Cods. It is highly prized, being considered especially fine flavored and fat. It is hardier than the other species and is frequently brought into the market alive. While all the other species caught on Cortes Banks ejected the stomach when brought to the surface, this species retained it. It equals *S. miniatus* in size and its infinite variations from bright scarlet to flesh color and dark olive render it sometimes difficult of determination. We soon found that if there was anything "curious" in the markets which in any way resembled this species it was pretty safe to call it *vexillaris*.

It is with young in February; the embryos are sometimes still alive when brought to market.

Sebastodes chrysomelas Jordan & Gilbert.

R. Smith, '85, June; E. & E., '89 (as *S. chrysomelas purpureus*).

Abundant in shallow water and usually discarded on account of its small size. It varies greatly in color and the variety named by us is scarcely worthy of a name. It does not frequently come into the markets, since the regular rock-cod boats usually go beyond its haunts to fish in deeper water.

S. carnatus Jordan & Gilbert.

R. Smith, '85, June.

Sebastodes serriceps Jordan & Gilbert.

J. & G., '80a, 455; *id.*, '81, 59; *id.*, '82, 676; R. Smith, '85, June; E. & E. '89.

Common, but not frequently brought to market.

Scorpæna guttata Girard. Sculpin.

J. & G., '80, 27; R. Smith, '80; J. & G., '80a, 455; *id.*, '81, 59; *id.*, '82, 679; R. Smith, '85, June; E. & E., '89.

Very abundant both in and outside the bay. It is not frequently brought from beyond Ballast Point, and is only occasionally taken in seines. It abounds especially about the piles of the various wharves and is caught with hook and line. The various spines about the head, which are said to be poisonous, do not make it a desirable fish to handle and its general appearance precludes it from coming into favor generally. It is said to be one of the best fishes of the bay.

Those caught in the bay are usually of a dull color, while those from outside are bright scarlet intermixed with other brilliant colors.

It was taken on Cortes Banks.

COTTIDÆ.

Leptocottus armatus Girard.

Girard, Pacific R. R. Survey, x, 60, 1859; J. & G., '80, 25; R. Smith, '80; J. & G., '80a, 455; *id.*, '81, 60; *id.*, '82, 713; R. Smith, '85, June.

Common in the bay. Of no economic importance.

Leiocottus hirundo Girard.

E. & E., '90, 21.

Only a single individual seen from the bay. Taken January 31, 1890.

Oligocottus analis Girard. (Plate xvii, Figs. 1–15.)

J. & G., '80, 25; R. Smith, '80; J. & G., '80a, 455; *id.*, '81, 59; *id.*, '82, 717; R. Smith, '85, June; E. & E., West. Am. Scientist, June, 1889.

Very abundant in all rocky ocean tide pools; never seen in the bay.

The spawning period probably extends over considerable time. Small specimens procured in the latter part of January have apparently ripe eggs. Of a large number of individuals collected on March 27, a single one was with ripe eggs, and the presence in tide pools of minute but fully developed individuals would indicate that the time of spawning extends back two or three months.

The eggs of the individual caught March 27 were artificially fertilized at 8 p. m. of that date. The eggs measure 1.2 millimeters in diameter, are of a brownish-yellow color, and have one large and from five to nine smaller oil globules. The larger globule measures about 150μ.

They are surrounded by a thick zona which appears to be perforated by two sets of canals, the usual fine canals and fewer much larger canals. In optical section these coarser canals appear as dark lines. The eggs readily adhere to each other, though they do not seem to possess the power of fastening themselves to foreign objects. When once fixed to each other they can scarcely be separated without injuring the zona.

Ten hours after fertilization, eggs with one, two, four, and eight cells, respectively, were observed (Figs. 1–7). Thirteen hours after fertilization the most advanced eggs showed the sixteen-cell stage. The cells in this stage do not seem to be definitely arranged as in the eight-cell stage. Sixteen hours after fertilization the two layers of cells have been formed (Fig. 8).

The blastoderm is completely segmented in thirty-five hours. At this time free nuclei are abundant. Stages immediately following are somewhat obscured by the opacity of the yolk. A well-advanced stage is represented by Fig. 9. The oil globules do not seem to have any definite relation to the blastoderm though they assume a more definite relation as soon as the embryo is outlined. At this stage they lie opposite the middle of the embryo; as the embryo grows over the yolk they come to lie just in front of the snout. By the further reduction of the yolk the oil globules finally lie beneath and slightly behind the auditory capsule. The posterior end of the embryos figured (in Figs. 9 and 10) terminates in a mass of large cells or rather small vesicles, the larger of which is situated below and may represent Kupffer's vesicle, while after sixty hours the gastrula covers half the yolk, the blastopore is closed in some of the eggs after eighty-six hours.

In the stage represented in Fig. 9 the yolk is covered by a network of fine lines which converge toward the tail of the embryo.

On the fifth day the auditory capsule and the heart make their appearance (Fig. 10). The heart lies somewhat to the left of the middle of the body. The body of the embryo at this time surrounds about half the yolk and the tail extends free one-third farther. The tail now lengthens rapidly, the pectoral fins being formed at the same time.

The circulatory system is next outlined; it is from the beginning decidedly sinistral. The liver is at this time represented by a vascular network overlying the yolk to the left of the embryo. The many vessels coming from the liver are collected in a large vein which at first is entirely on the left half of the yolk; at the time of hatching, however, it has been carried to the right side; with the reduction of the yolk this vein is greatly shortened in proportion to the veins emptying into it.

The pigmented regions are outlined by the eleventh day. They are at this time distributed as they are when the yolk is almost absorbed. Round orange dots are also present at this time along the pigmented area.

Peculiar granular cells or patches are formed about the head by the fourteenth day. These patches persist until the embryo is hatched

when they disappear within a very short time. Similar patches were seen in the smelt.

The first embryo hatched on the eighteenth day, the last on the 24th day. They measure from 3.7 to 4.2 millimeters.

The eyes at the time of hatching are well pigmented; in some of the embryos there is a pigment cell above the left eye, in some a cell over each eye, but in the latter case the one over the left eye is always the larger. A group of pigment spots lies on the nape, the upper two being somewhat removed from the rest. There is a broad black disk of pigment cells overlying the body cavity. Seen from the side it appears as a curved black bar; as seen from above it is shield-shaped. The individual cells forming this disk are contractile and the disk as a whole can be contracted to less than one half its normal size. This is usually done just before the larva moves. About thirty-four pigment cells lie along the base of the anal fin fold. Shortly after hatching the pigment cells near the tip of the tail send out pseudopods into the fin fold and a few days after hatching several pigment cells are seen in the fin fold at this point. A series of round orange cells margin the dark disk and are variously distributed over the head. These cells can be enormously expanded, giving the fish a bright yellow appearance.

At this time the mouth opens frequently, the intestines are well developed, and seem to contain foreign substance. The branchial filaments are just beginning to bud.

The oil globules, two in number, are fixed on the right side in the yolk just behind the head. The liver covers the upper left half of the yolk. As the yolk is reduced and the posterior intestines are more developed the liver is crowded forward and the green bile sack can be seen near its posterior border (Fig. 15).

The dorsal aorta is bent down near the tip of the tail and the larger vein is returned above to the place where the aorta is bent down, where it crosses it and returns to its normal position.

The median fin fold is continuous from the nape to the vent and did not undergo any marked changes before the yolk was absorbed except the formation of primitive rays in the tail.

There are no marked changes in the embryo from the time of hatching to the time the yolk is absorbed. Beyond that stage it was impossible to keep the young.

Icelinus australis E. & E.

E. & E., '89.

Known from two specimens taken from the mouth of a *Sebastodes* on Cortes Banks.

Paricelinus hopliticus E. & E.

E. & E., '89.

Known from a single specimen taken from the mouth of a *Sebastodes* on Cortes Banks.

Scorpænichthys marmoratus (Ayres).

J. & G., '80, 27; R. Smith, '80; J. &. G., '80a, 454; *id.*, '81, 60; R. Smith, '85, June.

Probably common near the kelp. It is seldom brought into the market and does not have a ready sale on account of its slimy appearance and its sometimes green tint.

AGONIDÆ.

Brachyopsis species?

E. & E., '89.

Fragments of a species of this genus were obtained from the stomachs of rock-cod on Cortes Banks.

GOBIESOCIDÆ.

Gobiesox rhessodon R. Smith.

R. Smith, Proc. U. S. Nat. Mus., 1881, 140; J. & G., '81, 63; *id.*, '82, 749; R. Smith, '85, June.

Common under rocks and among ulva and zostera on ocean beaches.

Gobiesox eigenmanni Gilbert.

Gilbert, Proc. U. S. Nat. Mus., XIII, 1890.

One specimen from among zostera at Point Loma.

BATRACHIDÆ.

Porichthys margaritatus Richardson.

Girard, Pacific R. R. Survey, X, 134, 1859; J. & G., '80, 27; R. Smith, '80; J. & G., '80a, 454; *id.*, '81, 65; *id.*, '82, 751; R. Smith, '85, June; E. & E., West Am. Scientist, May, 1889; E. & E., '89.

Very common everywhere, forming an important item in the food of rock-cod on Cortes Banks.

BLENNIIDÆ.

Isesthes gentilis Girard.

Steind. Ichthyol. Beitr. 149, 1876; J. & G., '82, 959; R. Smith, '85, June.

Very abundant in the bay in April and May. Ripe males and females were abundant May 29. They sometimes inhabit tin cans near low-tide mark. Their presence can be detected by the fact that the can and the space surrounding it are kept free from all visible organisms.

Isesthes gilberti Jordan. (Plate xvii, Figs. 16–20.)

J. & G., '80, 25 (as *H. gentilis*); R. Smith, '80; J. & G., '80a, 454; *id.* '81, 63; *id.*, 82, 757; R. Smith, '85, June; E. & E., West Am. Scientist, June, 1889.

This species is found associated with *Oligocottus analis*, *Clinus evides*, *Auchenopterus integripinnis* and *Heterostichus rostratus* in the rocky tide pools of the ocean beaches.

Ripe females were found March 27. The majority of the females were not ripe and the spawning time may be placed as April.

The eggs are quite remarkable in their structure and coloration. To the unaided eye they appear opaque, of a purplish pink color inside of which is a spot of brownish red and upon it a dot of opaque white.

The greater portion of the egg is covered by a thin transparent membrane but at one portion there is a large opaque cushion by which the egg fastens itself to foreign bodies. When fastened the egg becomes depressed. The longer axis measures 825μ, the shorter 562μ. The diameter of the cushiony cap is 975μ. This cap on sections of the ovary and of the ripe eggs is seen to be composed of innumerable very fine filaments, the tips of which are swollen and club-shaped. Their small size, the great number and their aggregation at one pole of the egg render their filaments different from all the other appendages of fish eggs yet described.

The yolk is composed of rather large spheres. On its upper surface are imbedded several pale yellow oil globules and about an equal number of bright purple oil globules (black in Fig. 16, pl. x.) In the middle of these is a larger white body the function of which is not known. Younger ovarian eggs 0.625 millimeters in diameter are entirely composed of purple spheres while still younger ones are colorless.

The germinal disk is always formed beneath the cap of filaments regardless of the position of the cap whether at the side, above, or below. This fact renders the early stages in the development obscure. The germinal disk is seen in Fig. 16. The first segmentation is completed in about ten hours after fertilization and results in two elongate cells whose longer axes lie parallel, Fig. 17. After fifteen and a half hours eight cells were observed. In this egg in which the cap was placed above, the oil globules and white disk appeared to lie below the germinal cells, a fact which would indicate that the oil globules were mobile in the yolk and tended to lie at the top. The oil globules therefore have, in this case, no influence on the position of the germ. Further stages in the segmentation of the germinal disk could not be observed.

The next stage which could be satisfactorily observed was one hundred and thirty-two hours old. It is represented in Fig. 19. The eyes at this time are well along in their development. The embryo embraces about half of the yolk and seems to be composed of large cells perfectly transparent. The purple oil globules (not figured) occupy the center of the field while the white body lies directly beneath the tail. Several black pigment cells have been found and lie on the yolk. The yellow oil globules still remain arranged about the white body.

On the seventh day the heart beats slowly. The pigment spots on the surface of the egg have greatly increased in number. It was now observed that the position of the embryos at this stage are independent of the opaque cap.

Clinus evides Jordan & Gilbert.

Steind. Beitr. v, 149, 1876 (as *Blakea elegans*); J. & G., '80, 27 (as *Gibbonsia elegans*); R. Smith, '80; J. & G., '80a, 454; *id.*, '81, 63; *id.*, '82, 763; R. Smith, '85, June.

Abundant on rocky ocean beaches and tide pools; never brought to market.

Heterostichus rostratus Girard. Kelpfish; Bandfish.

Girard, Pacific R. R. Survey X, 37, 1859; J. & G., '80, 25; R. Smith, '80; J. & G., '80a, 454; *id.*, 81, 63; *id.*, '82, 764; R. Smith, '85, June.

Common both in the bay and outside. It is rarely brought into the market, and is of no economic importance.

Auchenopterus integripinnis R. Smith.

R. Smith, Proc. U. S. Nat. Mus., III, 147, 1883; R. Smith, '80; J. & G., '80a, 454; *id.*, '81, 63; *id.*, '82, 764; R. Smith, '85, June.

Rare; in tide pools near La Jolla.

Neoclinus blanchardi Girard.

Girard, Pacific R. R. Survey X, 114, 1859.

Not seen by us.

FIERASFERIDÆ.

Fierasfer dubius Putnam. (Pl. xvi, Figs. 8–10.)

E. & E., '89a.

Some eggs were collected which probably belong to this species.

These eggs were incidentally procured with a dip net on Cortes Banks while fishing for other things. They are imbedded in a perfectly transparent jelly of the consistency of white of egg. The nature of the mass of eggs thus dipped up was not understood, as the eggs are quite as transparent as their matrix. There were through the whole mass sets of two black dots and a black streak, and on placing a portion in Perenyi's fluid the contour of the eggs was immediately made evident. The whole mass measured about half a pint. The eggs measured 0.8 millimeters and are arranged in one layer and separated from each other by a small space. Some of the eggs had hatched, and one of these larvæ is shown in Fig. 1. The pectorals are well developed. The eyes are black and the intestinal canal as far as developed is covered with dendritic pigment cells, a few of which extend on the yolk sack. Otherwise no pigment is developed.

OPHIDIIDÆ.

Otophidium taylori (Girard).

E. & E., '88.

This species is occasionally taken in the bay. It was abundant among the spewing of the rock-cod taken on Cortes Banks.

GADIDÆ.

Merlucius productus (Ayres).

E. & E., '90, 21.

Only three specimens of this species have been observed. The first was taken November 6, the other two January 9.

PLEURONECTIDÆ.

Citharichthys sordidus (Girard).

J. & G., '80, 23; R. Smith, '80; J. & G., '80a, 453; *id.*, '81, 67; *id.*, '82, 817; R. Smith, '85, June; E. & E., '89 (as *P. californicus*).

In deep water with Rock Cod. The first of the season were independently brought by several boats on October 7, 1889. It became quite abundant by the end of the month, but was never taken in quantity. It was seen as late as February 24. Whether it is not also found later, as is probable, I am unable to say. It has a ready market, but as only a few are caught it is of no great economic importance.

Eopsetta jordani (Lockington).

E. & E., '90, 23.

Only a single specimen has so far been recorded from San Diego waters. It was taken in about 100 fathoms outside the bay.

Paralichthys californicus (Ayres).

Girard, Pacific R. R. Survey, x, 147, 1859 (as *P. maculosus*); J. & G., '80, 27; R. Smith, '80; J. & G., '80a, 454; *id.*, '81, 66; *id.*, '82, 821; R. Smith, '85, June.

The young of this species are abundant in San Diego Bay throughout the year. The adult, or rather half grown, enter the bay in February. The species is taken with hook and line off wharves and in seines. Those caught in seines are mostly too small for capture. Near San Pedro large quantities of this species are taken with trawls about 5 miles off shore, in shallow water (5 fathoms) with sandy bottom. Similar methods have not been attempted at San Diego.

Hippoglossina stomata E. & E.

E. & E., '90, 22.

Known from two specimens taken in deep water November 7, 1889. The eggs measure 1.2 millimeters in diameter; the single oil globule, 0.16.

Xystreurys liolepis J. & G.

E. & E., '89a.

This species entered the bay during October and November. It was never in great abundance.

Pleuronichthys coenosus Girard.

R. Smith, '80; J. & G., '80a, 453; *id.*, '81, 68; *id.*, '82, 830; R. Smith, '85, June.

Abundant with the next. It is taken with seines in the bay. We found it with ripe eggs the latter part of April, and Mrs. Eigenmann procured it with ripe spawn August 22, 1882.

Hyspopsetta guttulata (Girard).

J. & G., '80, 27; R. Smith, '80; J. & G., '80a, 453; *id.*, '81, 68; *id.*, '82, 830; R. Smith, '85, June.

This species enters the bay in large numbers during February and March. Many are then caught with seines and with hand lines. Though the bulk of those entering the bay may not remain it is always more or less abundant.

Ripe individuals of both sexes were abundant in April and the eggs were procured with surface nets.

As stated under the head of *Sciæna saturna*, the eggs and larvæ of these two species resemble one another greatly. The color cells in this species do not appear till the gastrula covers two-thirds of the yolk, and on hatching there are a few more color cells on the tail than in *Sciæna*.

Symphurus atricauda Jordan and Gilbert.

J. & G., '80, 23; R. Smith, '80; J. & G., '80a, 453; *id.*, '81, 69; *id.*, '82, 842; R. Smith, '85, June.

Only one specimen of this species was brought to market (November 5). It is said to be abundant on muddy bottoms somewhat deeper than that reached by the ordinary seines.

TETRAODONTIDÆ.

Sphæroides politus (Girard.)

Girard, Pacific R. R. survey, x, 340, 1859; R. Smith, '80; J. & G., '80a, 453; *id.*, '81, 70; *id.*, '82, 860; R. Smith, '85, June.

Not seen by us.

DIODONTIDÆ.

Diodon hystrix L.

J. & G. '80a, 453; *id.* '81, 70.

Chilomycterus californiensis Eigenmann.

Am. Nat., 1891. Proc. U. S. Nat. Mus., 1892.

One specimen of this species was discovered at San Pedro.

MOLIDÆ.

Mola mola (Linnæus.)

R. Smith, '80; J. & G., '82, 866; R. Smith, '85, June.

This species is occasionally gaffed off Point Loma and stray individuals are at times drifted into the bay. It is probably migratory.

EXPLANATION OF PLATES.

The numbers and letters refer to ziess objectives and oculars. All the sketches were made with an Abbe camera unless otherwise stated.

PLATE X.

Figs. 1–5. *Stolephorus compressus.*

Fig. 1. First egg found April 24. A & 4.
2. Ovum procured April 26 and hatched in 60 hours. A & 4.
3. The same 10 hours after, Fig. 2. A & 4.
4. Another, older embryo. A & 4.
5. A larva some time after hatching. A & 4.

Figs. 6–9. Species No. 1.

Fig. 6. An undetermined egg, found August 14. A & 4.
7. The same four hours later. A & 4.
8. Another egg found August 28. A & 2.
9. The larva on hatching. A & 4.

Figs. 10–13. Species No. 2.

Fig. 10. An egg procured April 26.
Figs. 11–13. Later stages of the same.

PLATE XI. *Clupea mirabilis.*

These figures were made with a coverslip camera and a Bausch & Lomb 1-inch objective and B ocular.

Figs. 1–4. Forming blastodisk about one hour after fertilization.
5–14. The ingrowth and receding of the first cleavage furrow.
15. Beginning of second furrow.
16, 17. At completion of second segmentation.
18. At completion of third segmentation.
19. After 4 hours and a half.
Figs. 20. After eight hours and a half.
21. After twelve hours.
22, 23. After twenty-three hours.
24. After thirty-six hours.
25. After forty-five hours.
26. After forty-nine hours.
27. After fifty-four hours.
28. After fifty-five hours.
29. After seventy-eight hours.

PLATE XII. *Stolephorus ringens* and *delicatissimus.*

All figures drawn with an Abbe camera and A. and 2 of Zeiss.

Fig. 1. The blastoderm well segmented, bridging over the depression in the yolk forming the segmentation cavity. Optical section. The periblast lining the base of the cavity. Probably thirteen hours old.
2. Gastrula covering about half the yolk, the anterior and posterior lips equally advanced. Showing the segments of the yolk, which, for convenience, are omitted from the other figures.
3. About eighteen hours old.
4. Between nineteen and twenty hours old, showing that the blastopore closes at or very near the entodermic pole of the egg. 12:30 p. m., April 18.
5–10. Illustrate the different stages between Fig. 4 and the time of hatching. 5 sketched at 2:30 p. m.; 6 at 2:59 p. m.; 7 at 3:40; 8 at 4:45; 9 at 8:30; 10 at 4 p. m., April 19.
11. Sometime after hatching; 1:30 p. m., April 20; 1.47 millimeters long.
12. Sketched at 8 a. m., April 21, 1.79 millimeters long.
13. Sketched at 4 p. m., April 21, 2.12 millimeters long.
14. The oldest larva seen (forty-eight hours after hatching).

PLATE XIII. *Atherinopsis californiensis.*

All the figures are made from living eggs. Figs. 2–12 Abbe camera, D and 2; Figs. 1 and 13–23 Bausch and Lomb 1 inch and B, coverslip camera.

Fig. 1. Base of one of the filaments of the zona. The zona somewhat shriveled, the yolk having been removed.
2–9. A series of sketches showing one of the waves of contraction approaching the ectodermic pole, and the stage (Fig. 9) just preceding another of these waves.

Fig. 10. A late stage in the formation of the blastodisk.
11. Preparing to segment.
12. An early stage in the first segmentation.
13. Optical section at the completion of the first segmentation.
14. Surface view of the four blastomeres.
15. Surface view of the third segmentation furrows.
16. Optical section of sixteen cells.
17. Optical section after fourteen hours.
18. Optical section after twenty-four hours.
19. Optical section after thirty-two hours.
20. Diagram of embryo after sixty-four hours.
21. Diagram of embryo after seventy-five hours.
22. Embryo of six and a half days.
23. Embryo in later stage showing yolk circulation.
24. This is probably an *Atherinops* having been procured as late as April 22. It measured 5½ millimeters.
25. An *Atherinopsis* 9 millimeters long.
26. An *Atherinopsis* 12 millimeters long.
27. An *Atherinopsis* 14 millimeters long.

PLATE XIV.

Fig. 1. (Destroyed). Young *Clevelandia* or *Lepidogobius* taken with a surface net.
2. An older lava of the same.
3. Tail of a larvæ intermediate between Figs. 1 and 2.
4. Tail of an older larva.
5, 5a. *Clevelandia longipinnis.*
6, 6a. *Gillichthys y-cauda.*

PLATE XV.

Fig. 1. Egg of *Typhlogobius californiensis* undergoing the first cleavage.
2. Micropylar region of an egg of the same species under pressure, showing the margin of the attachment of the outer membrane.
3. An egg forced from the ovary. A very large breathing chamber has been formed. Abnormal (?).
4. A portion of the network of the outer membrane remote from the micropyle of the egg represented in Fig. 3.
5. Micropylar region of the egg represented in Fig. 3.
6. Adult *Typhlogobius*, natural size, in the position usually assumed in the aquarium.
7. Young *Typhlogobius*. ×4⅔, showing color markings and the eye.
8. Dorsal view of skull of *Typhlogobius*. ×⅞.
9. Lateral view of same. ×⅞.
10. Ventral view of same. ×1⅛.
11. Eye, optic nerves and portion of brain of same, showing the very much elongate slender optic nerves and the comparatively large lens as compared with the cup of the eye. × 24, from nitric acid maceration of a specimen 13 mm. long, January 29, 1888.
12. *Gillichthys mirabilis.* 21 millimeters long.
13. A single scale of same more enlarged.
14. Several scales with color cells from the tail of same.
15. Sense organs of the lateral line of a younger specimen of *Gillichthys*, from about the middle of the body.
16. Solitary sense organ of the same from the base of the caudal.

Plate XVI.

All the figures were drawn with an Abbe camera from dead or preserved specimens.

Figs. 1–3. *Sebastodes auriculatus.*

Fig. 1. An embryo some time before hatching, showing the large yellow oil sphere.
2. A larva shortly before hatching.
3. A larva just hatched.

Figs. 4–7. *Sebastodes ruber.*

Fig. 4. A larva shortly after hatching.
5–7. A larva shortly before hatching in different positions from the same ovary as Fig. 4.

Figs. 8–10. *Fierasfer dubius.*

8. A larva just hatched and still inclosed in the viscid mass; the vesicle surrounding the head may be an artificial condition caused by imperfect preservation.
9–10. An embryo in two different positions.

Fig. 11. *Sebastodes ovalis.*

11. An embryo of October 15.

Plate XVII.

Figs. 1–15. *Oligocottus analis.*

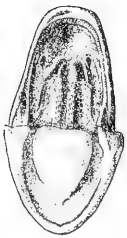
Fig. 1. The germinal disk ten hours after fertilization. × 50. Probably an unsegmenting egg, since the germ is well constricted off from the yolk.
2. The same, seen from above.
3. The two cells of another egg at the same time. × 50.
4. The egg represented in Fig. 3 seen in profile. × 50.
5. The four cells of another egg at the same time. × 50.
6. Another egg with eight cells after ten hours. × 50.
7. The same egg seen in profile.
8. The beginning of two-cell layers after sixteen hours × 50.
9. An embryo after eighty-four hours. × 50; showing how the zona-radiata is appressed by contact with another egg.
10. An embryo after five days.
11. An embryo eight days old.
12. Front view of an embryo seventeen days old.
13. Dorsal view of an embryo on the eighteenth day.
14. Dorsal view of a larva twelve hours after hatching.
15. A larva two days after hatching.

Figs. 16–20. *Icesthes gilberti.*

16. An egg shortly after extrusion, the shaded portion representing the salmon-colored yolk "y"; the black bodies represent the purple oil-spheres; the white bodies the yellow oil-spheres and the central shaded circle the opaque white globule. The germinal disk "g" is almost completely hidden by the cushion of filaments "f."
17. Two cells.
18. Eight cells seen through the cushion.
19. A larva one hundred and thirty-two hours old, the outline of a few of the yolk spheres in the center.
20. An embryo of the eighth day showing the circulation of the left side.

Plate XVIII.

Fig. 1. The youngest Typhlogobius seen. Zeiss A and 2.
2. The head of an older one from the side.
3. The head of one similar to Fig. 3. seen from below.
4. Another larva forty-eight hours older than Fig. 1. The oldest one seen. It is still inclosed in its club-shaped zona.



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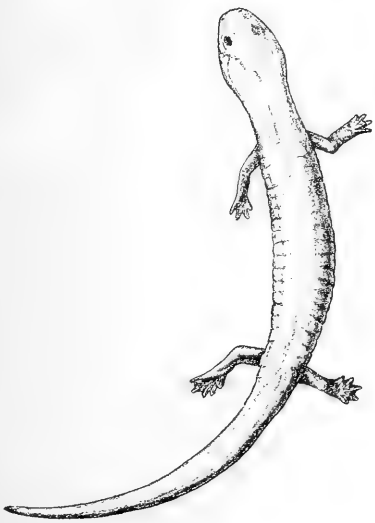

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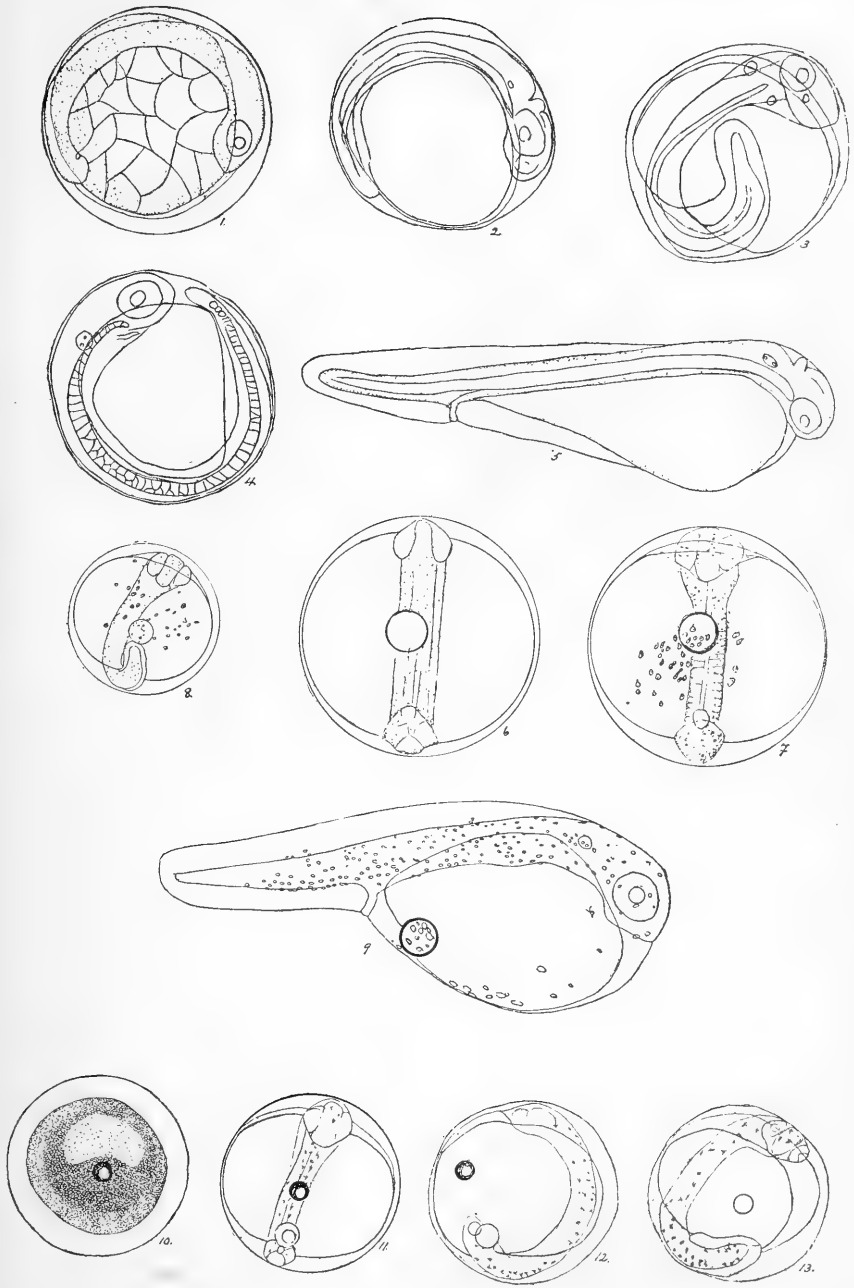
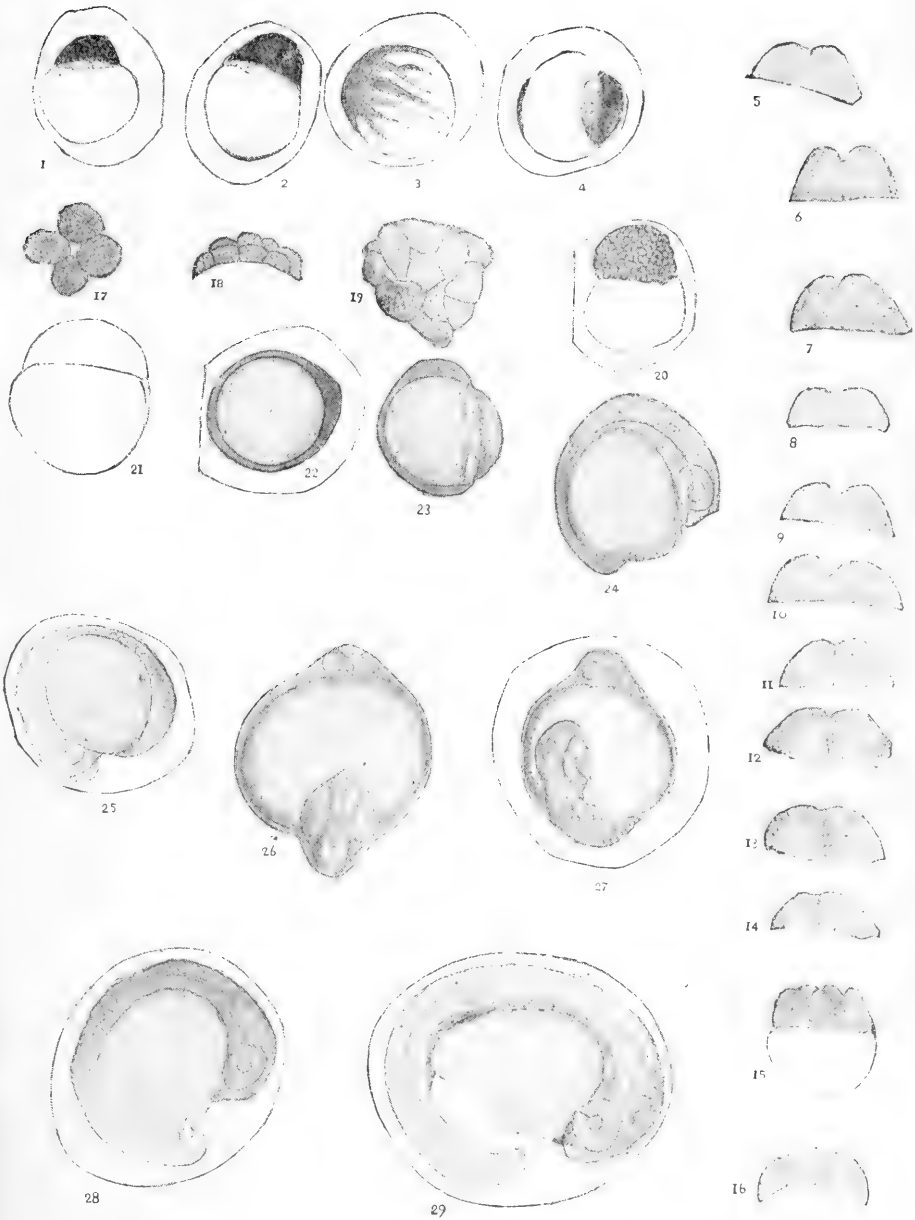
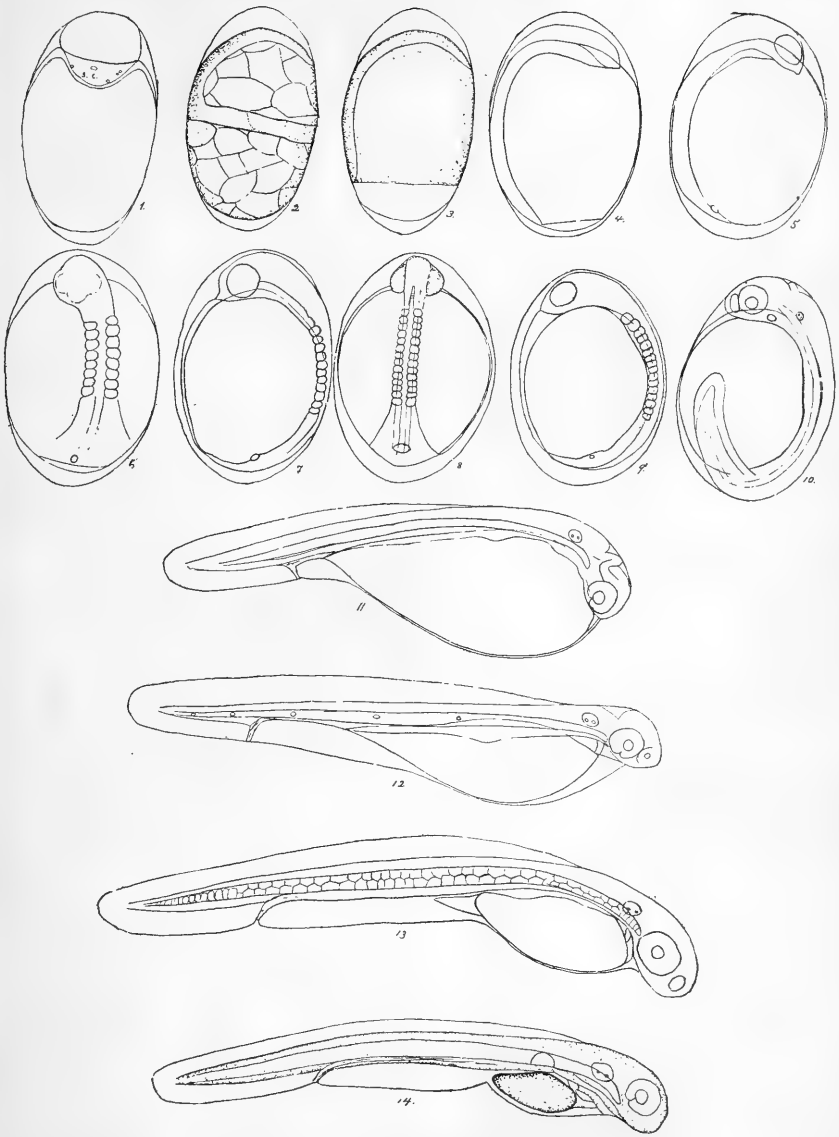
TYPHLOTRITON SPELÆUS Stejn.



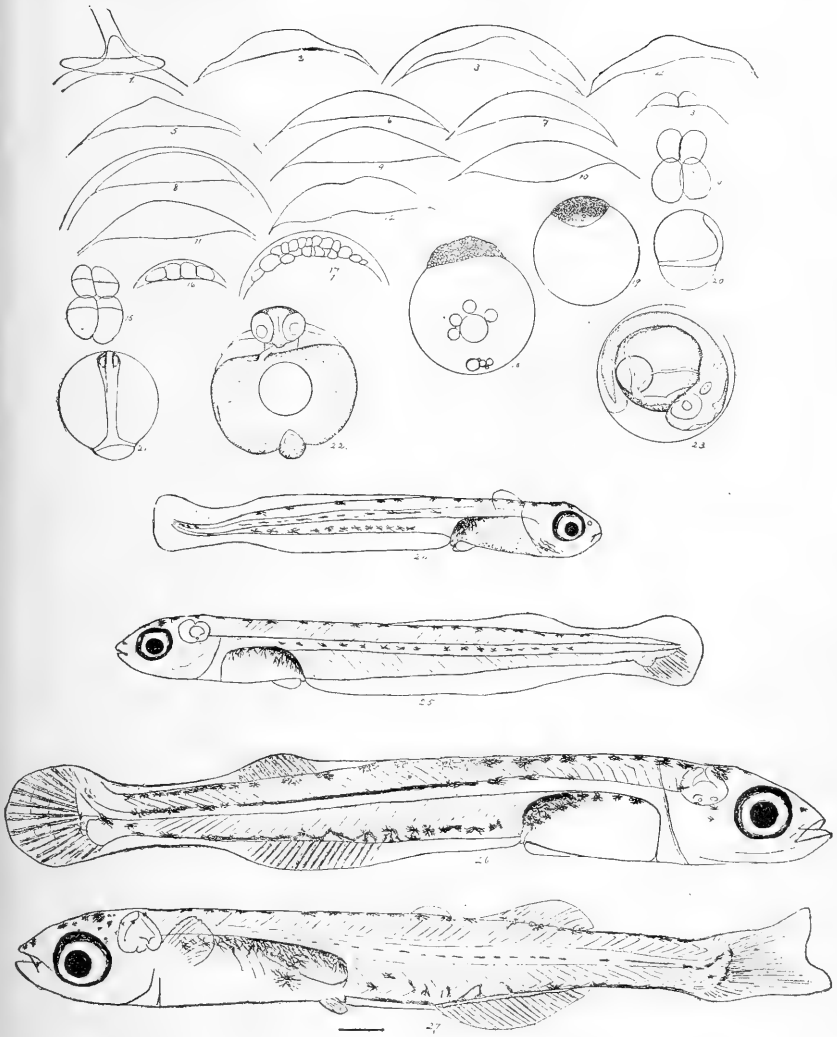
STOLEPHORUS COMPRESSUS.



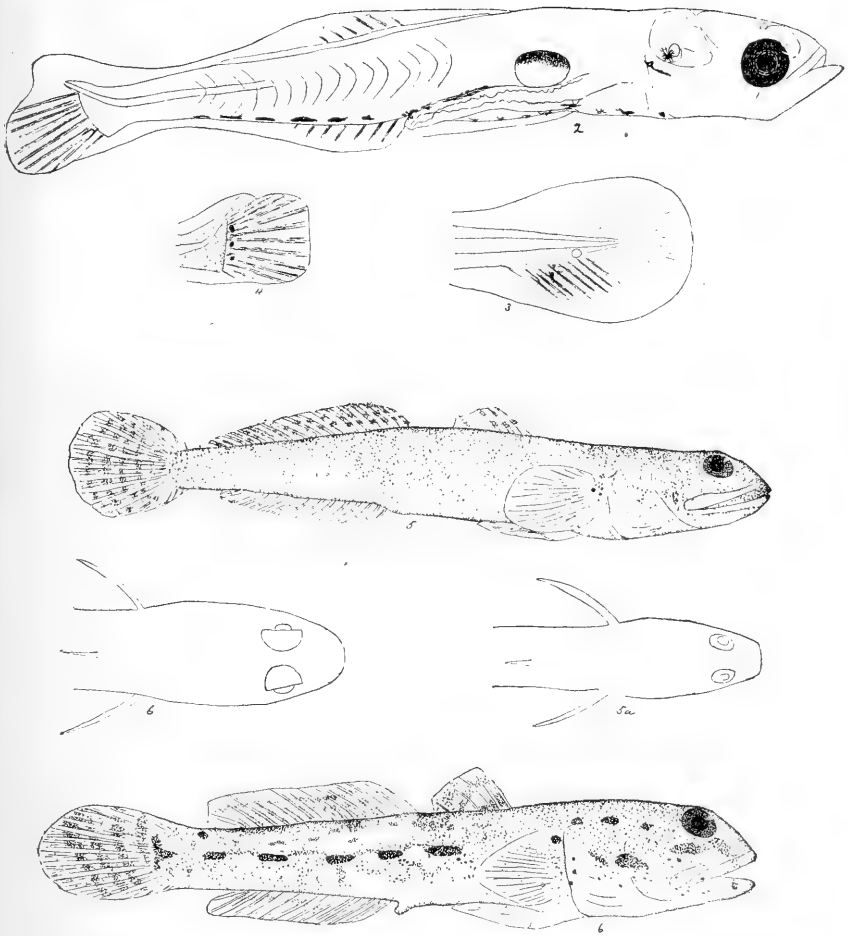
CLUPEA MIRABILIS.



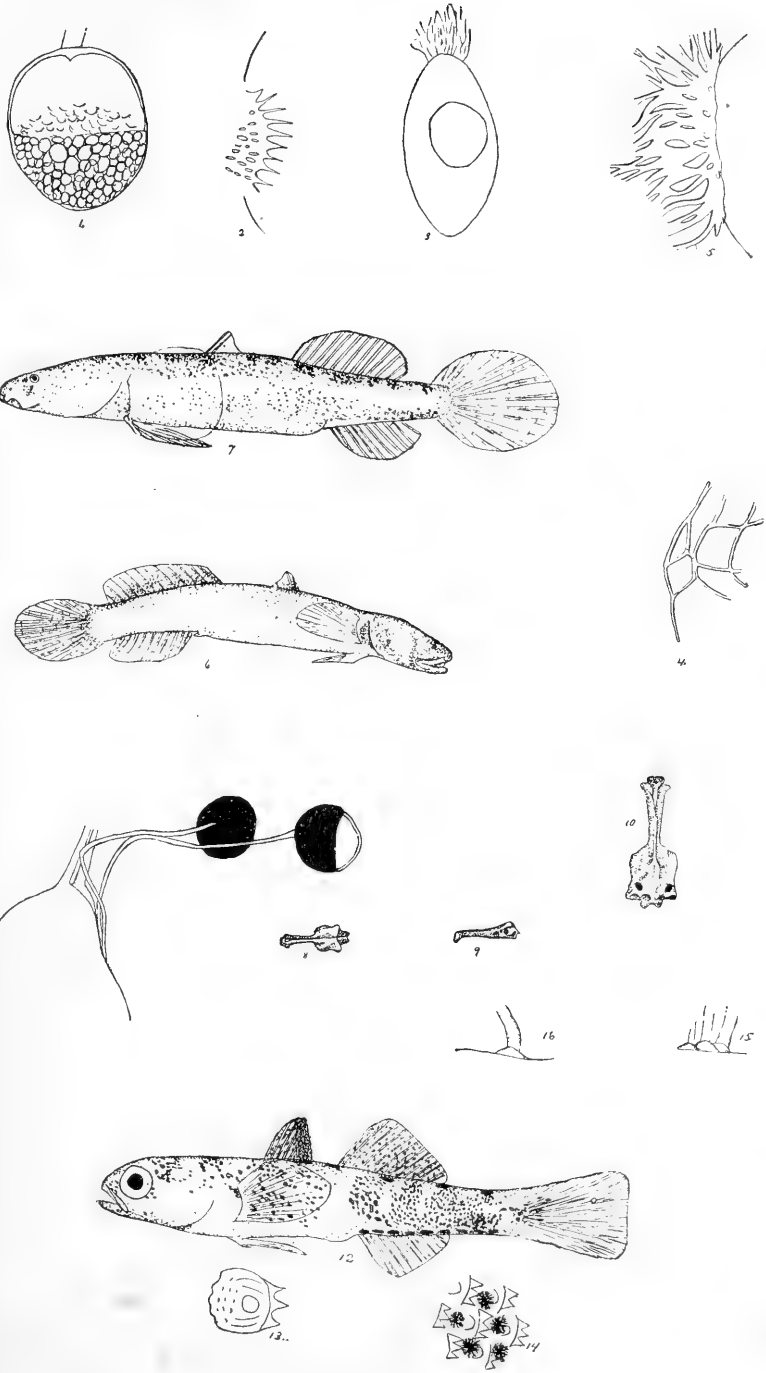
STOLEPHORUS RINGENS AND DELICATISSIMUS.



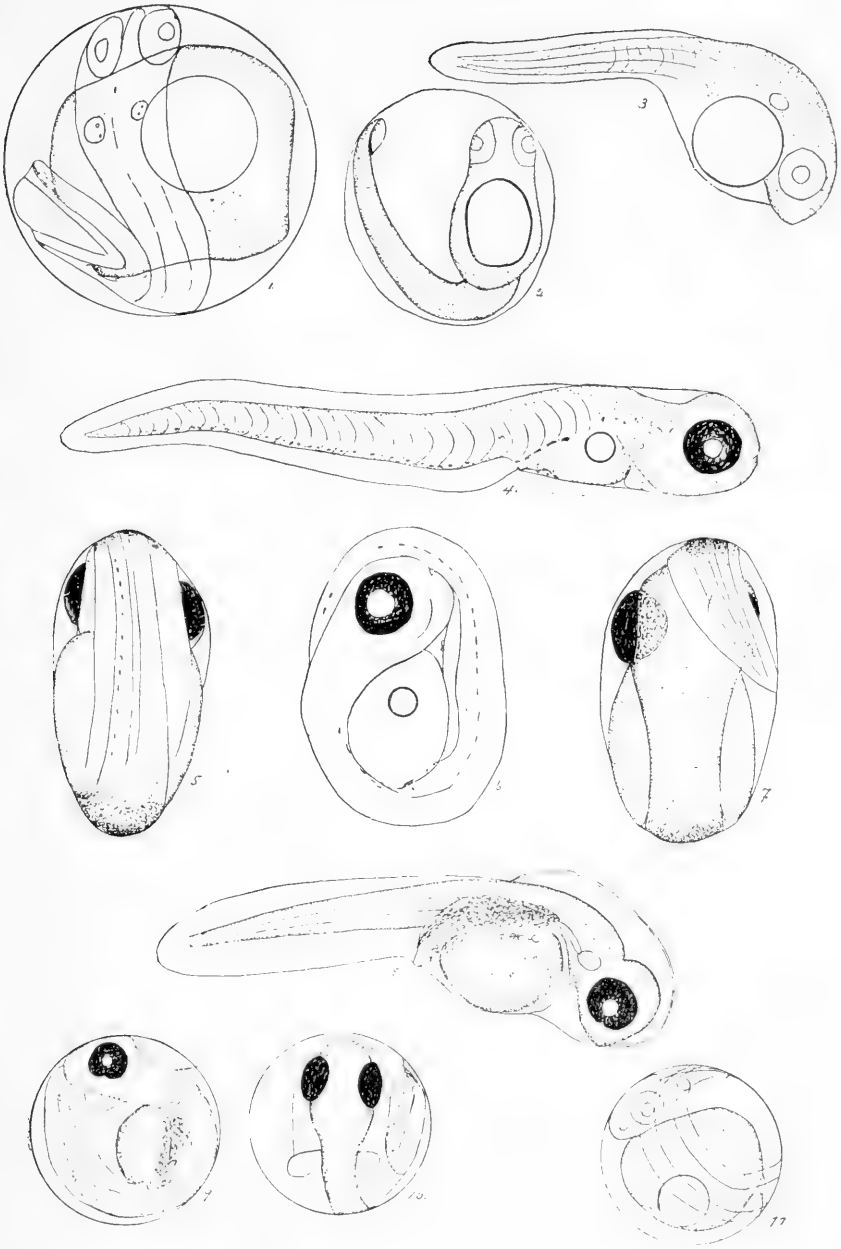
ATHERINOPSIS CALIFORNIENSIS.



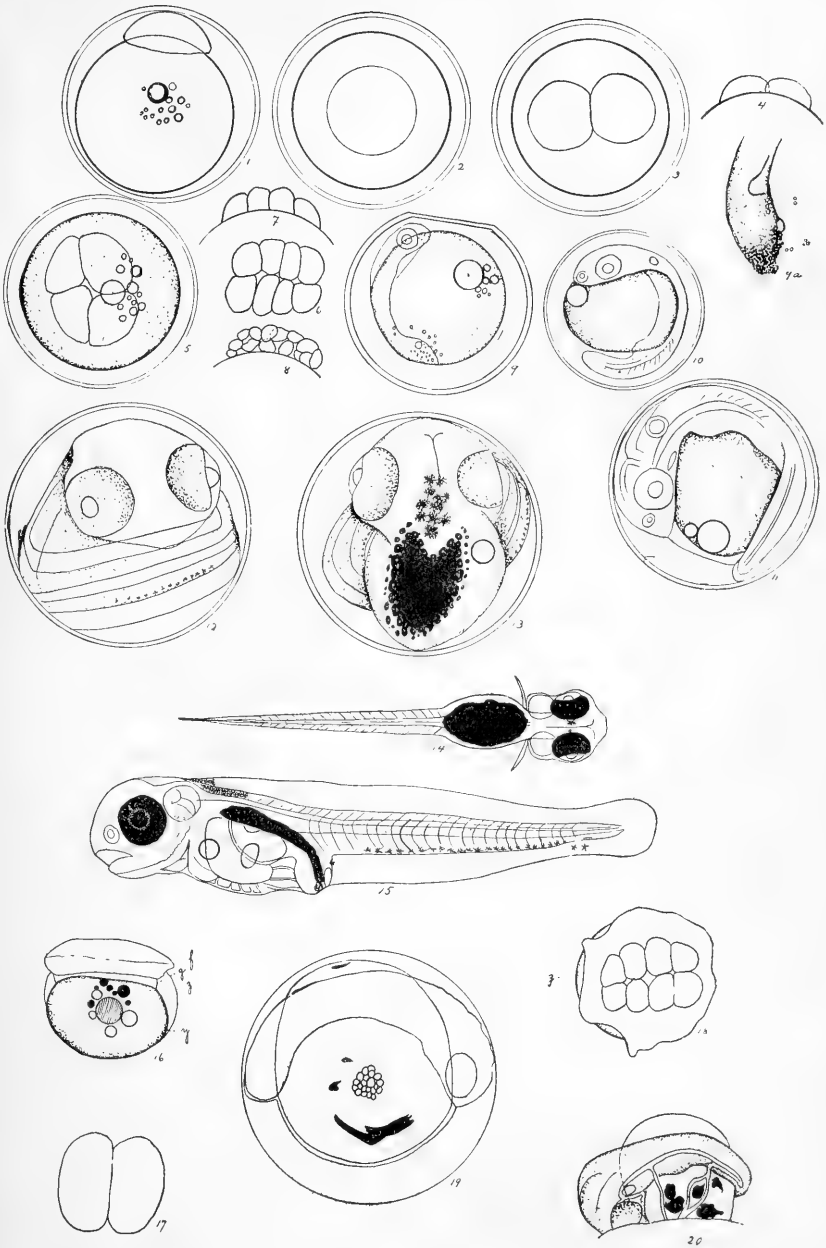
CLEVELANDIA AND GILLICHTHYS.



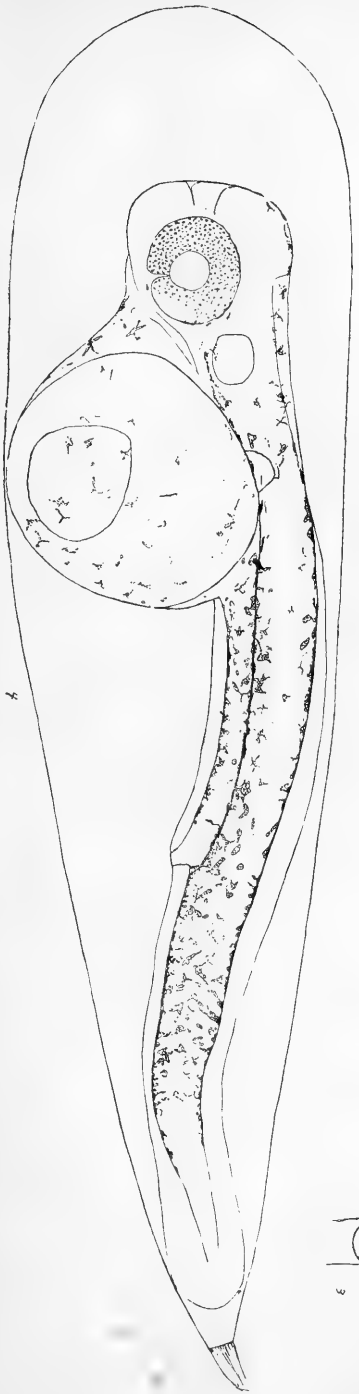
TYPHLOGOBIUS AND GILLICHTHYS.

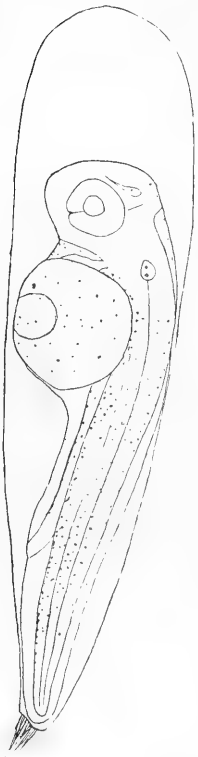


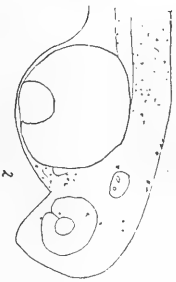
SEBASTODES AND FIERASFER.

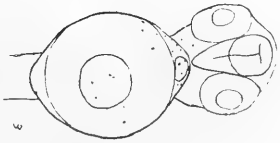


OLIGOCOTTUS ANALIS AND ISESTHES GILBERTI.









TYPHLOGOBIUS.

AN ANNOTATED LIST OF THE SHELLS OF SAN PEDRO BAY AND VICINITY.

BY

MRS. M. BURTON WILLIAMSON.

WITH A DESCRIPTION OF TWO NEW SPECIES BY W. H. DALL.

(With Plates XIX–XXIII.)

I have often thought if the fauna and flora of every inhabited county in the United States were studied and reported by careful, conscientious lovers of nature, the contributions to the natural history of our country would be of no small value, not only as a record of the riches of nature but, at a future time, as a history of the life that at a certain period was identified with a particular locality. For there is nothing permanent in nature. Her activity begets change, and change daily makes history.

With these thoughts in my mind I have undertaken to give a list of the marine shell fauna of Los Angeles County found, for the most part, within a period of two years. I am indebted to Mrs. L. H. Trowbridge and Miss I. M. Shepard for lists of shells found by them. Some of their shells have been identified, through me, by Dr. J. G. Cooper, but the greater part, especially the rarer forms, have been determined at the Smithsonian Institution, Washington, D. C. Miss S. P. Monks, teacher of drawing and zoology in the State normal school, in Los Angeles, has kindly allowed me to examine the shells found by her as well as those in the museum of the normal school.

There are still some shells that have not been identified.

The *Nudibranchiata* are not included in this list. *Doris* and *Eolis* have been found in San Pedro Bay and at Catalina Island, but not specifically determined.

INTRODUCTORY.

The coast of Los Angeles County is diversified by two large bays, Santa Monica and San Pedro, with their long sandy beaches separated by high, rocky cliffs. On the northwestern coast of the county the Sierra de Santa Monica range of mountains rises abruptly from the ocean. The extreme western point in this range is known as Point Dume, noted for its diatomaceous earth. Running back from this point the coast curves in until it reaches the sandy beach of Santa Monica Bay. In this bay *Tivela crassatelloides* and *Tapes staminea*

are most abundant. A laguna, known as Ballona Harbor, lies between Santa Monica and Redondo Beach. The latter is noted more for its pebbles than shells. South of Redondo is a long line of mountainous foothills that rise abruptly from the ocean. These foothills, with their mesas, are known as the Palos Verdes Hills. The rocky cliffs of the hills are called "points" where a trail down their sides makes it possible to descend to the beach below. One of these points, about seven miles south of Redondo, is called Point Vincente, where at low tide the *Haliotis Cracherodii* with other rock shells are found. Portuguese Bend, with its cave in the solid rock running nearly 100 feet under the cliff, lies about two miles south of Point Vincente. Out from this cave, whose stone floor is daily and almost hourly mopped by old ocean, the rocks at low tide lie uncovered for some distance on the beach. This is especially so at low tides in the winter, when our beautiful *Haliotis fulgens* (or *splendens*) is collected. The *Lottia gigantea* is most abundant at this point. From Portuguese Bend, Whites Point and Point Fermin (the light-house) are distinctly visible as they extend out into the ocean. Whites Point was at one time noted for its *Haliotis Cracherodii*, but continuous collecting has almost despoiled it of these shells. Point Fermin lies almost two miles south of Whites Point. Here as well as at the latter point *Chlorostoma* and *Acmæa* are plentiful. Between Point Fermin and San Pedro Bay is the pier known as the "old landing." Timms Point, in the bay, is a small, flat sand bar that lies below the western part of the city of San Pedro, which is built on the cliffs above the bay. *Bulla nebulosa* and *Liocardium substriatum* are found at Timms Point, near the oyster bed. Across from the town of San Pedro, in the bay, are two little islands that are connected by a long wall of stones known as the "breakwater." This breakwater is $1\frac{1}{4}$ miles long. Dead Man's Island (and any one who has read Dana's "Two Years Before the Mast" can conjecture why the island is so named) is little more than a miniature promontory of stone, with sandy soil on the summit. Around the top of this island, in the loose, sandy soil is a bed of Quaternary (or Postpliocene) fossil shells.* These shells are continually being washed out, and, falling below, they lie in the rock pools in company with the living shells. The breakwater that connects Dead Man's Island with Rattlesnake Island is the home of the *Acmæa* and *Chlorostoma*. Rattlesnake Island is one long, sinuous sand bar, destitute of vegetation, and in its widest part hardly more than a quarter of a mile across. Some of our rarest shells are found washed ashore in the drift on this island. Here on the bay side are *Chione* and *Cerithidea* as well as in the slough that lies between the towns of San Pedro and Wilmington. Between the latter and the town of Long Beach the San Gabriel River empties into the bay.

*At the base of this island are rocks that belong to the Pliocene and possibly Miocene strata, and many fossils of these older formations are washed out of the rocks by the ocean, and are collected with recent shells on the beach.

Long Beach supplies *Donax californicus*, a favorite clam for soup. At low tide the long, sandy drive on the strand between Long Beach and New River, a fork of the San Gabriel, is diversified by a small pile of soft rock, known as Devil's Gate, where a few rock Pholads are found. At the extreme south of San Pedro Bay is Alamitos, at the mouth of New River. Here are *Crepidula*, *Cerithidea*, *Melampus*, and *Pecten*. Laguna Beach, the home of *Trivia*, is 30 or 40 miles south, but in the recent division of Los Angeles County this beach was apportioned to the new county of Orange.

About 25 miles out in the Pacific Ocean is a little island, one of the Santa Barbara Islands, known as Santa Catalina. This mountainous stretch of land is included in Los Angeles County. This island is almost 27 miles long, and from 4 to 8 miles wide save at the isthmus. It is "chiefly metamorphic rock," and the beach is composed wholly of pebbles; many of these are a pure white. Collecting is confined to the small beaches that border the narrow valleys between the precipitous hills. *Haliotis* and *Lucapina crenulata* are found in the winter. In summer collecting is poor. Mr. Dall says, "The gravelly shores of Catalina Harbor on the south side are rich in small species."

In the following list, where the name of the bay is not given, San Pedro is intended.

The author gratefully acknowledges the assistance she has received through the kindness of Mr. William Healey Dall, Dr. Robert E. C. Stearns, and Mr. Chas. T. Simpson, of the Smithsonian Institution, and J. G. Cooper, M. D., of the California Academy of Sciences, in the determination, with notes, of a number of shells. The species so identified are, in each instance, noted by the initials in brackets of the gentleman to whom the species was referred. Mr. Dall has also kindly advised her relative to many changes in nomenclature.

(W. H. D.)—Mr. William Healey Dall, National Museum.
(R. E. C. S.)—Dr. Robert E. C. Stearns, National Museum.
(C. T. S.)—Mr. Charles Torrey Simpson, National Museum.
(J. G. C.)—J. G. Cooper, M. D., California Academy of Sciences.

The shells on the list identified at the Smithsonian Institution by Mr. Simpson were for the most part collected by Miss Shepard.

The number of southern shells lately added to the fauna of this vicinity is so great that some suspicion has been aroused as to the possibility of some of them being adventitious, but they are included in order that the question as to their provenance may be kept in view, and in time definitely settled by the collection of living specimens.

UNIVERSITY, P. O., LOS ANGELES COUNTY, CAL., *December*, 1890.

[NOTE.—In advance of a general revision of the classification of the Californian mollusk-fauna it has been thought most convenient in this list to retain the familiar arrangement of the late Dr. Carpenter.—W. H. Dall.]

LIST OF SPECIES.

BRACHIOPODA.

Family LINGULIDÆ.

Genus **GLOTTIDIA** Dall.

Glottidia albida Hinds. (*Lingula albida*, of authors.)

Found in the drift on the beach.

Family TEREBRATULIDÆ.

Genus **TEREBRATELLA** Orb.

Terebratella transversa Sby.

Seldom found alive. "This is the light-colored southern variety; the northern ones are much larger and duller. *T. occidentalis* is very like this, but has the fold in the middle line of the shell convex, while in *transversa* it is concave in the smaller valve." (W. H. D.)

MOLLUSCA.

Family PHOLADIDÆ.

Genus **ZIRPHÆA** Leach.

Zirphæa crispata Linn.

Seldom collected alive; separated valves common. At Bolinas Bay, near San Francisco, Mr. W. J. Raymond obtained the *Zirphæa* "by digging in soft sandstone with a pick. The burrows are from 12 to 15 inches or more, in depth, and the shells are very fragile. One has to dig a large hole around each specimen before venturing to break into the burrow."

Genus **PHOLADIDEA** Turton.

Pholadidea parva Tryon.

With *P. penita*, dead.

Pholadidea penita Conl.

A few in the soft rock at Devil's Gate.

Genus **NETTASTOMELLA** Cpr.

Nettastomella Darwinii Sby.

A few in soft rocks.

Genus **PARAPHOLAS** Conrad.

Parapholas californica Conr.

Two or three; with the soft parts gone.

Genus **PHOLAS** Linné.

Pholas pacifica Stearns.

Three or four washed ashore with the tide. Single valves not plentiful.

Family SAXICAVIDÆ.

Genus **SAXICAVA** F. de Bellevue.

Saxicava arctica Linn.

In algæ; also, with barnacles, at Redondo Beach.

Saxicava arctica, var. **pholadis** Linn.

One example.

Genus **GLYCIMERIS** Lamarck.

Glycimeris generosa Gld.

Rare; as single valves.

Family MYACIDÆ.

Genus **PLATYODON** Conrad.

Platyodon cancellatus Conr.

Not plentiful alive.

Genus **CRYPTOMYA** Conrad.

Cryptomya californica Conr.

Live ones at Point Fermin. Sometimes washed ashore in the bay.

Genus **SCHIZOTHÆRUS** Conrad.

Schizothærus Nuttallii Conr.

A few young shells. Single valves only of adults.

Family CORBULIDÆ.

Genus **CORBULA** Bruguière.

Corbula luteola Cpr.

A few live ones. Pink ones found on Actinia. "Varies in color to different shades of red, blue, brown and yellow." (J. G. C.)

Family PANDORIDÆ.

Genus **CLIDIOPHORA** Cpr.

Clidiophora punctata Cpr.

Single valves, in the beach drift. One live specimen reported by Miss Eleanor B. Green.

Family ANATINIDÆ.

Genus **PERIPLOMA** Schumacher.

Periploma planiuscula Sb y. (*P. argentaria* Conr., of authors.)

Eight or ten living shells. Single valves common. For notes on the specific name of this species, see Stearns's "West American Shells." Proc. U. S. Nat. Mus., XIII, No. 813, page 223.

Periploma discus Stearns.

This new shell, found in San Pedro Bay, is described by Dr. Stearns, as above mentioned, p. 222, pl. XVI, figs. 1, 2.

The first specimen was found by Mrs. D. Garlick, and soon after Miss Shepard and Mrs. Trowbridge found others in the bay. Since that time seven or eight shells have been collected.

Genus **THRACIA** Leach.

Thracia curta Conr.

Rare; in the bay; dead.

Genus **LYONSIA** Turton.

Lyonsia californica Conr.

Three or four dead shells. One live example in the drift at Rattlesnake Island, found by Mrs. Emma King.

Family SOLENIDÆ.

Genus **SOLEN** Linné.

Solen ensis Linné, var. **minor** Conr.

Several collected at Long Beach. (W. H. D.)

Solen rosaceus Cpr.

Washed ashore after storms.

Solen sicarius Gld.

Four or five.

Genus **TAGELUS** Gray.

Tagelus californianus Conr. (*Solecurtus californianus* Conr.)

Not uncommon in the Bay. "The generic name of the *Solecurtus californianus* and *S. subteres*, of Carpenter's list, is *Tagelus*. The true *Solecurtus* is a different shell." See Bulletin U. S. Nat. Mus. No. 37, p. 58; also, Dall, Report on *Albatross* Mollusca in Proc. U. S. Nat. Mus., Vol. XII, p. 243.

Tagelus californianus var. **subteres** Conr.

Found with the former. Epidermis, when present, very dark.

Genus **SILIQUA** Megerle.

Siliqua patula Dixon (*Machæra patula* of authors).

Three young shells reported from Long Beach.

Family TELLINIDÆ.

Genus **SANGUINOLARIA** Lamarck.

Sanguinolaria Nuttallii Conr.

Occasionally found alive.

Genus **PSAMMOBIA** Lamarck.

Psammobia rubroradiata Nutt.

Rare, empty shells only.

Genus **MACOMA** Leach.

Macoma indentata Cpr

When full grown, this species is as graceful as a *Tellina*. Usually found in the immature condition and in this state is very similar to a young *M. secta*.

Macoma nasuta Conr.

Plentiful with the preceding.

Macoma secta Conr.

Shells of this large species are commonly empty when collected.

Genus **TELLINA** Linné.

Tellina bodegensis Hds.

Fossil valves at Dead Man's Island. One young shell was found at Redondo Beach, by Miss Virgie Burton Williamson.

Tellina Idæ Dall.

Three shells. One fine one, collected by Mrs. Trowbridge has been figured, with description, by Mr. Dall in the Proceedings of the U. S. National Museum, Vol. XIV, No. 849, p. 183, pl. VI, fig. 3, pl. VII, figs. 1, 4, 1891.

This species is named in honor of Miss Ida M. Shepard, of Long Beach, who was the first to bring the recent shell to the attention of students. It is found fossil in the miocene of San Diego County (W. H. D.) and has been dredged off Catalina Island.

Tellina Gouldii Haml.

Rarely found.

Tellina obtusa Cpr.

Rare; soft parts gone.

Tellina variegata Cpr.

A few found by two collectors. (C. T. S.)

Genus **ŒDALINA** Cpr.

Œdalina subdiaphana Cpr.

A few living.

Subgenus COOPERELLA Cpr.

Œdalina (Cooperella) scintillæformis Cpr.

One broken shell. (C. T. S.)

Genus **LUTRICOLA** Blainville.

Lutricola alta Conr.

A few live shells washed ashore in the spring; single valves common.

Genus **SEMELE** Schumacher.

Semele californica Adams. (*S. flavescens* Gld.)

One young example. (C. T. S.)

Semele decisa Conr.

Not plentiful.

Semele pulchra Sby.

Mrs. Trowbridge reports a live shell washed ashore, after a heavy storm, in San Pedro Bay. (W. H. D.)

Semele rupium Sby.

Two or three; dead.

Genus **CUMINGIA** Sowerby.

Cumingia californica Conr.

Alive at Point Fermin, between the ledges of rock, in company with Chitons.

Genus **DONAX** Linné.

Donax californicus Conr.

This little shell, rich in color-variations, is one of our "economic mollusca;" for it makes a palatable soup. Plentiful at Long Beach.

Donax flexuosus Gld.

Not often found living.

Genus **HETERODONAX** Mörch.

Heterodonax bimaculatus D'Orb.

Plentiful at San Pedro.

Heterodonax bimaculatus, var. **purpureus**.

This purple variety is common with the type.

Heterodonax bimaculatus, var. **salmoneus**.

This variety is salmon-pink, and is rare. Some shells have also been found that are canary colored.

Family MACTRIDÆ.

Genus **MACTRA** Linné.

Mactra (Standella) californica Conr.

Two single valves. These valves are each nearly 5 inches long.

Mactra (Standella) planulata, var. **falcata** Gld.

Often washed ashore in the spring. (W. H. D.)

Mactra (Standella) nasuta Gld.

Not plentiful. This shell is of a blue-white color, with a dingy gray, epidermis, and is thinner than the former species. Of the Mactridæ, Mr. Dall says, "names at present must be provisional."

Genus **LABIOSA** Schmidt.

Labiosa undulata Gld. (*Raeta undulata* Gray).

Single valves washed ashore in winter. Pairs not separated are very rare.

Family VENERIDÆ.

Genus **CALLISTA** Poli.

Callista (Amiantis) callosa Conr. (*Dione nobilis* Reeve).

This graceful bivalve is found at low tide in winter, in the bay; occasionally washed ashore.

Callista (Lioconcha) Newcombiana Gabb. Pl. XXIII, Fig. 4.

Two shells and three or four valves; Catalina.

Genus **TIVELA** Link.

Tivela crassatelloides Conr. (*Pachydesma crassatelloides* Conr.).

One of our "economic mollusca," but not as plentiful as the *Chione*. The largest shells are often used by local artists as plaques, on which miniature pictures of "old missions," etc., are painted. These shells

are from 5 to 5½ inches in length, but I have one that measures 6 inches, and weighs 22 ounces. The large shells soon lose their epidermis, so smaller ones are preferred for cabinet specimens.

Genus **PSEPHIS** Cpr.

Psephis tantilla Gld.

Rare. Arnold.

Genus **VENUS** Linné.

Venus toreuma Gld. (*Venus Fordii* Yates).

Valves not rare at Catalina Island. Two perfect examples found on the island. Two or three valves reported from San Pedro Bay. Dr. Yates's figure agrees perfectly with Gould's type. (W. H. D.)

Genus **CHIONE** Megerle.

Chione fluctifraga Sby.

This and the two following species belong to our "economic mollusca," although this is the least abundant of the three.

Chione simillima Sby.

Our most plentiful *Chione*. This species shows some variation.

Chione succincta Val.

In mud flats, with the two former species.

Chione undatella Sby. (=*C. excavata* Cpr. of California).

Worn valves comparatively plentiful at Catalina Harbor, in 1890. "The extreme limit north for it." (W. H. D.)

Genus **TAPES** Megerle.

Tapes grata Say.

Two shells found by two collectors. (W. H. D.)

Tapes laciniata Cpr.

Seldom found alive.

Tapes staminea Conr.

This "economic mollusk" of our coast is smaller than the other forms of this genus.

Tapes staminea, var. **diversa** Sby.

A few with the type.

Tapes tenerrima Cpr.

Rare; dead.

Genus **SAXIDOMUS** Conrad.

Saxidomus aratus Gld. (*S. gracilis* Gld.).

Often washed ashore in the spring. This shell, like others of the family, varies in form.

Saxidomus Nuttallii Conr.?

Beach-worn valves; may be specimens of the preceding species.

Genus **RUPELLARIA** F. de Bellevue.

Rupellaria lamellifera Conr.

Two dead shells reported.

Family PETRICOLIDÆ.

Genus **PETRICOLA** Lamarck.

Petricola carditoides Conr.

Only dead ones collected.

Petricola cognata Ads.

One broken valve. (W. H. D.) Mrs. Trowbridge.

Petricola tenuis Ads.?

One, young, dead. (C. T. S.) If not a form of *carditoides* this has hitherto been known only from the southern fauna.

Family CHAMIDÆ.

Genus **CHAMA** Brug.

Chama exogyra Conr.

Common on rocks, from which they are hard to remove, even with a hatchet, as one valve usually adheres firmly. Both sinistral and dextral shells occur in the same colony.

Chama pellucida Sby.

This species is more pellucid and frilled, and often of a bright rosy tint in some places. It is usually washed ashore from deep water.

Chama spinosa Sby.

Very rarely washed ashore. These three forms are sometimes difficult to distinguish; one species appears to run into another.

Family CARDIIDÆ.

Genus **CARDIUM**.

Cardium centifilosum Cpr.

One valve; Mrs. Trowbridge. Abundant in 16 fathoms at Catalina Harbor. (W. H. D.)

Cardium quadragenarium Conr.

Found at very low tide in the spring. Deep water examples are sometimes 6½ inches from the umbo to the basal margin of the valves. Also found fossil at Dead Man's Island.

Subgenus HEMICARDIUM Cuvier.

Cardium (Hemicardium) biangulatum Sby.

Fresh valves, and two or three complete shells collected at Catalina. "Alive in twenty to thirty fathoms near Catalina Island." (J. G. C.)

Subgenus LIOCARDIUM (Sw.) Mörch.

Cardium (Liocardium) elatum Sby.

One or two juvenile valves reported.

Cardium (Liocardium) substriatum Conr.

Plentiful at times.

Family CARDITIDÆ.

Genus **VENERICARDIA** Lamarck.

Venericardia ventricosa Gld.

Two shells; San Pedro Bay. Arnold. Dredged off Catalina Island in 30 fathoms.

Genus **LAZARIA** Gray.

Lazaria subquadrata Cpr.

Single valves occasionally found. Complete shells very rare.

Family LUCINIDÆ.

Genus **LUCINA** Brug.

Lucina californica Conr.

A few found alive at the Points.

Lucina æquizonata Stearns.

Dredged in 276 fathoms off the Santa Barbara Islands by the U. S. Fish Commission.

Lucina Nuttallii Conr.

Washed ashore in the bay.

Family DIPLODONTIDÆ.

Genus **DIPLODONTA** Bronn.

Diplodonta orbella Gld.

Living examples are very rare.

Family KELLIIDÆ.

Genus **KELLIA** Turton.

Kellia Laperousii Deshayes.

At San Pedro, and also with barnacles on the pier at Redondo.

Kellia rotundata Cpr.

One "Nearly like *K. suborbicularis*." (C. T. S.)

Kellia suborbicularis Mont.

Rare. (C. T. S.)

Genus **LASEA** Leach.

Lasea rubra Mont.

Not rare on kelp.

Genus **TELLIMYA** Brown.

Tellimya tumida Cpr.

One specimen found. (C. T. S.)

Family MYTILIDÆ.

Genus **MYTILUS** Linné.

Mytilus bifurcatus Conr.

A few on the pier at Santa Monica.

Mytilus californianus Conr.

One of our "economic mollusks" though not often on sale.

Mytilus edulis Linné.

Rare on the shore; brought in by fishermen, and occasionally on sale in the fish market.

Genus **SEPTIFER** Recluz.

Septifer bifurcatus Rve.

Plentiful with *Litorina planaxis* between rocks.

Genus **MODIOLA** Lam.

Modiola capax Conr.

Living shells rare; dead valves not uncommon.

Modiola fornicata Cpr.

Shells, fasciculated by their byssus, often washed ashore.

Modiola modiolus Linné.

Two or three young specimens found in San Pedro Bay.

Modiola recta Conr.

Not many found. None exceeding three inches in length.

Subgenus ADULA H. & A. Ad.

Modiola (Adula) falcata Gld.

Two or three, in soft rock; none large.

Genus **LITHOPHAGUS** Megerle.

Lithophagus plumula Hanl.

A few; living.

Family ARCIDÆ.

Genus **ARCA** Linné.

Arca mutabilis Sby.

One badly sea-worn valve. "Probably adventitious, as we do not know of it from north of the gulf." (W. H. D.)

Arca multicostata Sby.

Single valve; Catalina Island. "Commonly found along the coast of Lower California." (R. E. C. S.)

Genus **AXINÆA** Poli.

Axinæa intermedia Brod.

One found in the bay. "Very fine, highly colored specimen." (W. H. D.) Miss Monks.

Family NUCULIDÆ.

Genus **NUCULA** Lam.

Subgenus ACILA H. & A. Ads.

Nucula (Acila) castrensis Hinds.

Single valves (all fossil?) Dead Man's Island.

Family LEDIDÆ.

Genus **LEDA** Schumacher.

Leda cælata Hds.

Odd valves reported.

Genus **YOLDIA** Mörch.

Yoldia Cooperi Gabb.

Valves washed ashore in the beach drift. "May be identical with the fossil *Y. impressa*," Conr. (J. G. C.)

Family LIMIDÆ.

Genus **LIMA** Brug.

Lima orientalis (Adams?) Cpr. (*L. dehiscens*, Conr., of Cal. authors).

Valves washed ashore in the spring.

Family AVICULIDÆ.

Genus **AVICULA** Lamarck.

Avicula peruviana Rve.

One valve washed ashore on Rattlesnake Island and collected by Mrs. Opar. This is one of the shells from the southern fauna referred to in the introduction as possibly adventitious.

Family PECTINIDÆ.

Genus **PECTEN** Linné.

Pecten æquisulatus Cpr.

At San Pedro and Alamitos.

Pecten caurinus Gld.

Single valves are not rare at Dead Man's Island. All fossil? Two live examples found by Mrs. D. Garlick.

Pecten latiauritus Conr.

This shell has been labeled *P. monotimeris* Conr. by many collectors on this coast, but Mr. W. H. Dall, to whom I recently submitted a series of shells collected at Redondo Beach, San Pedro Bay and San Diego, pronounced them all *P. latiauritus*. Not plentiful. Fossil at Dead Man's Island.

Section JANIRA Schumacher.

Pecten (Janira) floridus Hds.

Several valves; all fossil? "Evidently fossil and belonging in the recent state to the Lower Californian fauna." (W. H. D.) A living specimen referred by Carpenter to *J. dentata* and perhaps conspecific was dredged by Dr. Cooper at Monterey. Living specimens of *P. floridus* have been obtained at San Pedro. (W. H. D.)

Genus **HINNITES** Defrance.

Hinnites giganteus Gray.

Occasionally found living.

Family OSTREIDÆ.

Genus **OSTREA** Linné.

Ostrea lurida Cpr.

Plentiful in a small oyster bed near Timms Point.

Ostrea lurida var. **expansa** Cpr.

Three or four found at Catalina Island and the Bay.

Family ANOMIIDÆ.

Genus **PLACUNANOMIA** Brod.

Subgenus MONIA Gray.

Placunanomia (Monia) macroschisma Desh.

Single valves rare. One fine example, measuring 3½ by 3 inches, has been reported by Miss Eleanor B. Green, of Minnesota, who informs me that this shell, found alive at Long Beach, varies considerably from the type. "The shell varies much like an oyster." (J. G. C.)

Genus **ANOMIA** Linné.

Anomia lampe Gray.

Odd valves and two young shells reported.

SCAPHOPODA.

Genus **DENTALIUM** Linné.

Dentalium hexagonum Sby.

Empty shells in the sand at Rattlesnake Island.

Dentalium pretiosum Nuttall.

With the last, but more plentiful.

PTEROPODA.

Family CAVOLINIIDÆ.

Genus **CAVOLINIA** Abild.

Cavolinia tridentata Forsk. = *Hyalea tridentata*, of authors.

Three or four of these little Pteropods have been washed ashore at Long Beach. (J. G. C.)

Family CYMBULIIDÆ.

Genus **COROLLA** Dall.

Corolla spectabilis Dall.

This Pteropod has been taken alive on the surface of the sea off the coast north of Catalina Island. (W. H. D.) *Cymbuliopsis* of Pelseneer is synonymous.

Family PNEUMODERMATIDÆ.

Genus **PNEUMODERMON** Cuvier.

Pneumodermon pacificum Dall.

This Pteropod has been taken alive near San Pedro. (W. H. D.)

GASTROPODA.

Family UMBRACULIDÆ.

Genus **TYLODINA** Rafinesque.

Tylodina fungina Gabb.

One shell, San Pedro Bay, and two found at Laguna Beach, by two collectors. (C. T. S.)

Family BULLIDÆ.

Genus **BULLA** Linné.

Bulla nebulosa Gld.

Plentiful on mud flats. Usually of a dark reddish-brown color.

Genus **HAMINEA** Leach.

Haminea vesicula Gld.

Very rarely washed ashore.

Haminea virescens Sby.

In moss at Catalina. Empty shells not rare in the Bay; live ones very rare.

Family ACTAEONIDÆ.

Genus **ACTAEON** Montfort.

Section RICTAXIS Dall.

Actæon (Rictaxis) punctocælatus Cpr.

Three or four dead examples.

Family TORNATINIDÆ.

Genus **TORNATINA** A. Adams.

Tornatina carinata Cpr.

A few examples. (J. G. C.)

Tornatina culcitella Gld.

Empty shells; not plentiful.

Tornatina inculta Gld.

One example.

Genus **VOLVULA** A. Adams.

Volvula cylindrica Cpr.

One example in coarse sand in a rock-pool. (W. H. D.)

Family AURICULIDÆ.

Genus **MELAMPUS** Montfort.

Melampus olivaceus Cpr.

Plentiful in mud-flats.

Genus **PEDIPES** Blainville.

Pedipes unisulcatus J. G. Cp.

Washed ashore in the drift.

Family SIPHONARIIDÆ.

Genus **SIPHONARIA** Sby.

Subgenus WILLIAMIA Monterosato.

Siphonaria (Williamia) peltoides Cpr.

One worn shell found in the bay. (C. T. S.)

Family GADINIIDÆ.

Genus **GADINIA** Gray.

Gadinia reticulata Sby.

A single dead shell reported.

Family MOPALIIDÆ.

Genus **MOPALIA** Gray.

Mopalia ciliata Sby.

Not rare on rocks.

Mopalia lignosa Gld.

Rarer than *M. ciliata*.

Family ACANTHOPLEURIDÆ.

Genus **NUTTALLINA** Cpr.

Nuttallina scabra Rve.

The most plentiful form of Chiton.

Family ISCHNOCHITONIDÆ.

Genus **CHÆTOPLEURA** Shuttleworth.

Chætopleura (Maugerella) conspicua Cpr.

Between ledges of rock at Point Fermin, also at White's Point. Lately identified by Dr. R. E. C. Stearns. This species has been distributed under the name of *Stenoradsia Magdalenensis*.

Chætopleura Hartwegii Cpr.

On rocks; not plentiful.

Family ACMÆIDÆ.

Genus **ACMÆA** Eschscholtz.

Acmæa asmi Midd.

A few at Point Vincent.

Acmæa insessa Hds. (*Nacella incessa* Hds. of some California authors).

Dead examples occasionally found in good condition in San Pedro Bay, and at the Points.

Acmæa mitra Esch.

Dead shells; very rare.

Acmæa paleacea Gould. (*Nacella paleacea*, Gld., of some California authors).

Found on kelp.

Acmæa patina Esch.

Abundant on the rocks at San Pedro and Point Fermin.

Acmæa patina var. **scutum** Esch.

Very few found with *A. patina*.

Acmæa pelta Esch.

Very few found.

Acmæa persona Esch.

Not plentiful.

Acmæa scabra Nutt.

With *A. patina*, but not so plentiful as the latter.

Acmæa spectrum Nutt.

Plentiful; on the rocks.

Genus **LOTTIA** Gray.

Lottia gigantea Gray.

Plentiful at Portuguese Bend.

Family FISSURELLIDÆ.

Genus **FISSURELLA** Brug.

Fissurella volcano Rve.

Most plentiful at Portuguese Bend.

Genus FISSURIDEA Swainson, 1840 (=*Glyphis* Carpenter, 1856, non Agassiz 1843).

Fissuridea aspera Esch.

Rare; not found living.

Fissuridea murina (Cpr.) Dall. Proc. U. S. Nat. Mus., 1885, p. 543.

Two found dead, one at Catalina. [This is the *Glyphis densiclathrata* of Californian conchologists, but not of Reeve; *G. saturnalis* of Pilsbry

(Nautilus, v., p. 105) not of Carpenter, and *G. densiclathrata* var. *murina* of Carpenter. W. H. D.]

Fissuridea rugosa Sby.

Two found at White's Point. This is one of the southern species of shells referred to in the introduction as possibly adventitious. Arnold.

Genus **LUCAPINA** Gray.

Lucapina crenulata Sby.

Plentiful at Catalina, in the winter. Three or four live examples found, by as many persons, at the Points, and Dead Man's Island.

Genus **MEGATEBENNUS** Pilsbry.

Megatebennus bimaculatus Dall. (*Fissurellidea* and *Clypidella* of authors).

Two found in the bay.

Genus **LUCAPINELLA** Pilsbry.

Lucapinella callomarginata Cpr. (*Clypidella* of Cpr.).

Three dead shells. One live example found by M. Estella Williamson.

Family HALIOTIDÆ.

Genus **HALIOTIS** Linné.

Haliotis corrugata Gray.

Dead shells not often found. Live ones occasionally brought in by fishermen.

Haliotis Cracherodii Leach.

Plentiful in winter, at low tide, on the rocks. This is the "white" Abalone (pronounced "Ab'-a-lō-nĕ") of California, and a favorite edible shellfish of the Mexicans. Although the mother-of-pearl of these shells is usually white when decorticated, one shell picked up in San Pedro Bay, by Mrs. Emma King, when decorticated, presented a beautiful play of colors, unlike either the type or *H. fulgens*. The muscular scar was also finely colored. The spire rising higher than usual in shells of this type made the specimen more cup-shaped.

Haliotis Cracherodii var. **splendidula**.

A number of shells, found at one time, at Point Vincent, have brilliant blotches of color in their interior somewhat like *H. fulgens*. Some have spots of brown color.

Haliotis fulgens Phil. (*H. splendens* Rve.).

As the former name has precedence, according to Mr. H. A. Pilsbry, he substitutes it for *H. splendens*. This splendid shell is sometimes found very large at Portuguese Bend, at low tide, in the winter.

Family PHASIANELLIDÆ.

Genus **PHASIANELLA** Lam.

Phasianella compta Gld.

Usually empty shells; not plentiful.

Family TURBINIDÆ.

Genus **POMAULAX** Gray.

Pomaulax undosus Wood.

Plentiful in the early spring at Dead Man's Island.
These shells lie close together in shallow water, many with a growth of algæ on their apical whorls; when the algæ are highly colored they present a beautiful sight under the water.

Genus **PACHYPOMA** Gray.

Pachypoma inæquale Martyn. Pl. XIX, figs. 4 and 5; pl. XXIII, figs. 1, 3 and 5.

A half dozen; all fossil? Not uncommon, living, on the shore of Catalina island. This is the *P. gibberosum* of Chemnitz, according to Carpenter, but Martyn's name is four years older. (W. H. D.)

Genus **LEPTOTHYRA** Carpenter.

Leptothyra bacula Cpr.

Not many shells found. Plentiful under stones in one of the valleys on Catalina Island.

Leptothyra Carpenteri Pilsbry (*L. sanguinea* of Carpenter, not of Linn.).

Very rare. In the *Nautilus* for July, 1890, Mr. H. A. Pilsbry says: "To our Californian shells we give the name of *L. Carpenteri*." The true *L. sanguinea* is Mediterranean.

Family DELPHINULIDÆ.

Genus **LIOTIA** Gray.

Liotia acuticostata Cpr.

On actinias or sea anemones sticking to the adhesive surface; rare.

Liotia fenestrata Cpr.

Empty shells; rare.

Family TROCHIDÆ.

Genus **ETHALIA** H. & A. Adams.

Ethalia sp.

San Pedro. "Close to *multistriata* Ver." Found at Cape St. Lucas. (W. H. D.) Arnold.

Genus **NORRISIA** Bayle.

Norrisia Norrisii Sby. (*Trochiscus Norrisii*, of authors).

Plentiful on kelp at Dead Man's Island. "The name *Trochiscus* is preoccupied." (W. H. D.)

Genus **CHLOROSTOMA** Swainson.

Chlorostoma aureotinctum Fbs.

Most plentiful at White's Point.

Chlorostoma brunneum Phil. Pl. XXI, fig. 8.

Very few, none large.

Chlorostoma funebrale A. Ad. Pl. XXI, fig. 7.

A few at the Points.

Chlorostoma funebrale var. **subapertum** Cpr. Pl. XXI, fig. 6.

U. S. National Museum, No. 123496. This unfigured variety is here illustrated for comparison. (W. H. D.)

Chlorostoma gallina Fbs.

Our most abundant species. Some vary from the type by the absence of the numerous spots or speckles.

Chlorostoma gallina var. **pyriformis** Cpr.

A half dozen of this variety have been found. One very fine example on Rattlesnake Island, by Mrs. Charles Burton Woodhead. (J. G. C.)

Chlorostoma gallina var. **tincta** Hmp.

One shell found at Portuguese Bend. This variety has rounded whorls and is not speckled.

Chlorostoma Montereyensis Kien. (*C. Pfeifferi* Phil. of Cal. lists).

Rare; dead.

Section **OMPHALIUS** Phil.

Chlorostoma (Omphalius) viridulum var. *ligulatum* Mke. (*Omphalius fuscescens.* Phil. of California authors).

Not rare; sometimes inhabited by crabs.

Chlorostoma (Omphalius) globulus Cpr.

One shell (C. T. S.). This form was described by Carpenter from Mazatlan (Maz. Cat., 235), but is not mentioned by Mr. Pilsbry in his monograph of the group. (W. H. D.)

Genus **CALLIOSTOMA** Swainson.

Calliostoma annulatum Mart. Pl. XXII, fig. 2.

One beach-worn shell reported. (Trowbridge.)

Calliostoma canaliculatum Mart. Pl. XXII, fig. 6.

Rare; only empty shells found.

Calliostoma gemmulatum Cpr. Pl. XXII, fig. 3.

Very good specimens are found in the bay; not plentiful.

Calliostoma gloriosum Dall. Pl. XXII, fig. 5.

Four or five good shells, all dark spotted, found at San Pedro Bay. At Soquel, Monterey Bay, this species is mostly of a pale salmon color; the southern ones are darker. (W. H. D.)

Calliostoma splendens Cpr. Pl. XXI, Fig. 5.

One found; dead. (C. T. S.)

Calliostoma supragranosum Cpr.

One obtained; not found living. (C. T. S.)

Calliostoma tricolor Gabb. Pl. XIX, Fig. 8.

Examples are usually faded.

Calliostoma versicolor Mke.

One young specimen found. (C. T. S.)

Calliostoma costatum Mart. Pl. XXII, fig. 1.

Rare on San Miguel Island. (W. H. D.)

Genus **THALOTIA** Adams.

Thalotia caffea Gabb. (*Ptychostylis caffea* Gabb.).

Three recent, also fossil shells, at Dead Man's Island.

Genus **GIBBULA** Risso.

Gibbula Canfieldii Dall.? var.

One dead shell. "Possibly an extreme form of the very variable *lirulata*. Whether *Gibbula* or *Margarita* will depend upon the anatomy. The shell has the habit of *Gibbula*." (W. H. D.) Trowbridge.

Genus **MARGARITA** Leach.

Margarita lirulata Cpr.

Rare living. Of *Margarita lirulata* Cpr., *M. acuticostata* Cpr., *Gibbula optabilis* Cpr., *G. parcipicta* Cpr., *G. succincta* Cpr., *funiculata* Cpr., and *lacunosa* Cpr., Mr. Dall says: "After a careful study of the types of

the above and hundreds of specimens, I am compelled to the belief that they are simply forms of one protean species."

Margarita pupilla Gld.

A dead one reported.

Genus **SOLARIELLA** S. Wood.

Solariella cidaris A. Ad. Pl. XXII, fig. 4.

Dredged in deep water off the islands by the U. S. Fish Commission.

Solariella peramabilis Cpr.

One or two specimens found. Dredged off Catalina living in 30 fathoms. Also found fossil.

Genus **CANTHARIDUS** Montfort.

Subgenus HALISTYLUS Dall.

Cantharidus (Halistylus) pupoideus Dall. Pl. XIX, Fig. 2. (*Fenella pupoidea* Cpr., not of A. Adams.)

Four found in rocky pools at Dead Man's Island. For an account of this genus see these Proceedings, XII, p. 341. The original *Fenella* is a Rissoid.

Family CYCLOSTREMATIDÆ.

Genus **VITRINELLA** Adams, em.

Vitrinella Williamsoni Dall. Pl. XXI, figs. 2 and 3.

Shell small, white, depressed, with two and a half whorls; spire flattened; suture appressed with a shallow channel or excavation outside of the appressed margin of the whorl, outside of which the convexity of the whorl rises higher than the suture. Base slightly more rounded than the upper side, with a wide and flaring umbilicus; periphery rounded; aperture rounded, oblique; surface polished, finely striate here and there by the incremental lines which are most prominent above. Maximum diameter of shell, 5.5; minimum diameter, 4.5; altitude, 1.25 millimeters.

Beach at San Pedro; U. S. National Museum, registered number 106,856.

This species, which is rather large for a *Vitrinella*, is respectfully dedicated to Mrs. M. Burton Williamson, to whose researches this paper is due. The name being inherently masculine, the usual genitive ending is preserved.

Family CALYPTRAEIDÆ.

Genus **CRUCIBULUM** Schumacher.

Crucibulum imbricatum Brod. (*C. scutellatum* Gray, of Cooper Geographical Catalogue).

One in a collection of shells found on Santa Catalina Island, and two found in San Pedro Bay. From southern fauna.

Crucibulum spinosum Sby.

Washed ashore in the drift. Young ones found alive on *Pecten æquisulcatus*. Plentiful alive, at very low tide in the oyster bed at San Pedro.

Genus **CREPIDULA** Lam..

Crepidula aculeata Gmel.

One or two reported.

Crepidula adunca Sby.

A few found living.

Crepidula dorsata Brod.

Not rare; these shells vary much in color and habit.

Crepidula excavata Brod.

Shells with the soft parts gone are sometimes found in the drift. "Does not exactly agree with any of our shells, but is probably this." (C. T. S.)

Crepidula explanata Gld. (*C. eruviata* Nutt.).

Three or four, found by two or three collectors.

Crepidula navicelloides Nutt.

Plentiful in dead gastropods.

Crepidula onyx Sby. var. **rugosa** Nutt.

Plentiful, often in clusters, one on another, and variable in shape. I have one old beach-worn example, of which the outline on one side describes a semicircle. Shells found on *Norrisia* are of a light magenta-pink in the interior. The form of the septum, or deck, of the pink, shells that I have seen varies from that of the var. *rugosa*.

Genus **GALERUS** (Humphr.) Gray.

Galerus mammillaris Brod. (*G. fastigiatus* Gld., perhaps *G. contortus* Cpr.).

Two found dead at Long Beach. (C. T. S.)

Family AMALTHEIDÆ.

Genus **AMALTHEA** Schum., 1817 (*Hipponyx* Defrance, 1819.)

Amalthea antiquata Linn.

Empty shells are washed ashore at the bay. A few found living with *A. tumens*, nestled close to some big Chitons (*Mangerella conspicua*) in a cleft of rock at Point Fermin.

Amalthea cranioides Cpr.

Rare; with *A. antiquata*. This shell is flat and has the apex near the center.

Amalthea serrata Cpr.

Two or three found at San Pedro. These shells have a brown epidermis, in irregular patches.

Amalthea tumens Cpr.

With *A. antiquata*, but not so plentiful.

Family VERMETIDÆ.

Genus **SERPULORBIS** Sassi.

Serpulorbis squamigerus Cpr.

Less plentiful than the variety below.

Serpulorbis squamigerus Cpr., var. **pennatus** Mörch.

Usually found in colonies on the rocks.

Genus **BIVONIA** Gray.

Bivonia compacta Cpr.

Only dead shells found; rare. (J. G. C.)

Genus **SPIROGLYPHUS** Daudin.

Spiroglyphus lituella Mörch.

On kelp; Catalina Island and Portuguese Bend. (R. E. C. S.)

Family CÆCIDÆ.

Genus **CÆCUM** Fleming.

Cæcum crebricinctum Cpr.

Ten or twelve found at San Pedro; dead. (C. T. S.

Family TURRITELLIDÆ.

Genus **TURRITELLA** Lam.

Turritella Cooperi Cpr.

Dead shells are not uncommon; living ones very rare.

Turritella (Mesalia) lacteola Cpr.

Three found. (C. T. S.)

Family CERITHIIDÆ.

Genus **CERITHIDEA** Swainson.

Cerithidea californica Held. (1840 + *C. sacrata*, Gld. 1849, + *C. pullata* Gld.).

Plentiful on mud flats. "Several variations are caused by the amount of freshness in the water; sometimes marked by yellow bands." (J. G. C.)

Genus **BITTIUM** Leach.

Bittium asperum Cpr.

Dead Man's Island. Fossil in San Pedro City. (J. G. C.)

Bittium quadrifilatum Cpr. Pl. XXI, fig. 4

A few found living.

Family LITTORINIDÆ.

Genus **LITTORINA** Fér.

Littorina planaxis Nutt.

Abundant on rocks.

Littorina scutulata Gld.

Less abundant than the former.

Littorina scutulata var. *plena* Gld.

A few with the type.

Littorina scutulata var.

Six or eight. This variety is small and almost black.

Genus **ASSIMINEA** Leach.

Assiminea californica Cooper.

One living and one dead example at San Pedro. (C. T. S.)

Genus **LACUNA** Turton.

Lacuna unifasciata Cpr.

Three dead.

Lacuna solidula Lovèn.

Rare living; San Pedro. (C. T. S.)

Family FOSSARIDÆ.

Genus **ISAPIS** Cpr.

Isapis fenestratus Cpr.

Rare; rock pools. Also fossil in San Pedro City. (J. G. C.)

Family RISSOIDÆ.

Genus **RISSOA** Freminville.

Rissoa (Alvania) reticulata Cpr.

One example. (C. T. S.) *Rissoina purpurea* of Cooper.

Family TRUNCATELLIDÆ.

Genus **TRUNCATELLA** Risso.

Truncatella californica Pfr.

On sea weed, not many found. (C. T. S.)

Truncatella Stimpsoni Stearns.

One. (C. T. S.)

Family JEFFREYSIIDÆ.

Genus **JEFFREYSIA** Alder.

Jeffreysia sp.

One worn specimen found near Dead Man's Island. (W. H. D.)

Jeffreysia translucens Cpr.

Three or four. (C. T. S.)

Family OVULIDÆ.

Genus **OVULA** Bruguiére.

Ovula (Simnia) deflexa Sby. var. *barbarense* Dall. Pl. XXI, fig. 1.

One example, one inch in length, found in San Pedro Bay, by Miss Monks.

[*O. deflexa* is a southern form, but was reported by Col. Jewett from Santa Barbara. His specimen was probably the same as the form here figured, which is of a whitish color and does not seem to agree perfectly with Sowerby's figures. I therefore separate it varietally until more is known. If it prove distinct from *deflexa* the varietal name may take specific rank. W. H. D.]

Family CYPRÆIDÆ.

Genus **CYPRÆA** Linné.

Cypræa spadicea Gray.

Living, at the Points. Also Laguna Beach. Not plentiful in Los Angeles County.

Genus **TRIVIA** Gray.

Trivia californica Gray.

In the coarse sand at the Points, Dead Man's Island, and Santa Catalina Island. Three live ones washed ashore at San Pedro; also living at Laguna Beach.

Trivia Solandri Gray.

With the preceding and more plentiful.

Genus **ERATO** Risso.

Erato columbella Mke.

Not often found, and not reported living.

Erato vitellina Hds.

Good examples are rare.

Family TEREBRIDÆ.

Genus **TEREBRA** Brug.

Section ACUS Adams,

Terebra (Acus) simplex Cpr. (*Myurella simplex* Cpr.).

Dead shells not rare. Ten or twelve live ones in the sand on Timm's Point.

Terebra (Acus) specillata Hinds.

White, with irregular brown markings. Three or four of these pretty forms have been found in the bay. "They will probably be found to grade into *T. simplex*." (W. H. D.)

Family PLEUROTOMIDÆ.

Genus **PLEUROTOMA** Lam.

Pleurotoma tuberculata Gray.

One shell found by Mrs. Purdy, of Los Angeles.

Subgenus GENOTA Adams.

Section DOLICHOTOMA Bellardi.

Pleurotoma (Dolichotoma) Carpenteriana Gabb. (*Surcula Carpenteriana* Gabb.)

Rare, dead. One splendid example, four and one-eighth inches long,

was found alive at Ballona Harbor by Mrs. Spar. For notes on Genota —section Dolichotoma—see Report on Albatross Mollusca, Dall, Proc. U. S. Nat. Mus., vol. XII, No. 773, p. 303.

Genus **DRILLIA** Gray.

Drillia inermis Hd.

Found with *Cerithidea californica*, at Alamitos, by M. Estella Williamson. Also fossil; in San Pedro City bluffs.

Drillia penicillata Cpr.

Living shells seldom found; usually inhabited by crabs. A beautiful species with wavy hair lines across the whorls.

Drillia torosa Cpr. var.

Three shells, all broken. This variety is spotted. Point Fermin. (J. G. C.)

Genus **MANGILIA** Risso.

Mangilia striosa C. B. Ad.

Rare; dead. The generic name is taken from an Italian conchologist who was called Mangili.

Subgenus CYTHARA Schumacher.

Mangilia (Cythara) variegata, Cpr. (*Mangilia variegata* Cpr., var. *nitens*, of West Coast lists).

Three or four live examples. (W. H. D.)

Genus **MITROMORPHA** Adams.

Mitromorpha aspera Cpr. Pl. XIX, fig. 3.

One. (C. T. S.)

Mitromorpha filosa Cpr. Pl. XIX, fig. 1.

One (young) broken. (C. T. S.)

Family CONIDÆ.

Genus **CONUS** Linné.

Conus californicus Hds.

Plentiful in moss at Point Fermin. Washed ashore in the bay with live Crepidulæ on them.

Family PYRAMIDELLIDÆ.

Genus **PYRAMIDELLA** Lam.

Pyramidella conica Ads. var. *variegata* Cpr. (*Obeliscus*).

Three or four dead shells. (W. H. D.)

Genus **ODOSTOMIA** Fleming.

Odostomia gravida Cpr.

A few living. (J. G. C.)

Odostomia inflata Cpr.

Alive on the back of a *Haliotis corrugata* brought in by a fisherman.

Odostomia nuciformis, Cpr.

A few dead shells.

Genus **TURBONILLA** Leach.

Turbonilla chocolata Cpr. (*Chemnitzia*).

One young specimen, dead, found at San Pedro. (C. T. S.)

Turbonilla stylina Cpr.

One young specimen. (C. T. S.)

Turbonilla aurantia, Cpr. (*Chemnitzia* var. *aurantia* Cpr.).

Three faded ones. (C. T. S.)

Turbonilla tenuicula Gould.

One specimen. (C. T. S.)

Turbonilla tenuilirata Cpr.

Two examples. (C. T. S.)

Turbonilla torquata Gld. var.

Three dead specimens. (C. T. S.)

Family EULIMIDÆ.

Genus **EULIMA** Risso.

Eulima micans Cpr.

Dead specimens, rarely found.

Family SCALIDÆ.

Genus **SCALA** Humphrey.

Scala bellastriata Cpr. (*Scalaria bellastriata* Cpr.).

Good examples found in the beach drift. One found alive by Mrs. Trowbridge.

Scala Hindsii Cpr.

With the former species, not rare. A southern form first collected at Santa Barbara by Col. Jewett.

Scala indianorum Cpr.

Rare; dead; also fossil.

Scala occidentalis Nyst.

San Pedro (W. H. D.) Arnold. New to the fauna.

Scala retiporosa Cpr.

One dead shell. (C. T. S.)

Subgenus OPALIA Adams.

Scala (Opalia) borealis Gld.

Three or four examples; all fossil?

Scala (Opalia) crenata Linn. var. **crenatoides** Cpr.

A few dead shells. One live shell, Portuguese Bend, found by M. Estella Williamson. Alive at Laguna Beach. "Abundant off Catalina Island, in mud at 16 fathoms." (W. H. D.)

Family CERITHIOPSIDÆ.

Genus **CERITHIOPSIS** F. & H.

Cerithiopsis fortior Cpr.

"Shells too much broken to be sure of identity." (J. G. C.)

Cerithiopsis munita Cpr.

One, dead. "Slender form." (J. G. C.)

Cerithiopsis purpurea Cpr.

Three. (C. T. S.)

Cerithiopsis tuberculata Mont.

Very few; dead.

Family JANTHINIDÆ.

Genus **JANTHINA** Lam.

Janthina exigua Lamk. (*Janthina bifida* Totten; *J. trifida*, of California authors).

One day in March, last year (1889), a number of these ocean snails were washed ashore at Long Beach. This year (1890) not one has been found in the bay that I have heard of, but in the early spring months some were washed ashore at Catalina Island.

Family CANCELLARIIDÆ.

Genus **CANCELLARIA** Lam.

Cancellaria Cooperi Gabb. Pl. XXII, fig. 2.

Three sea-worn examples of this rare and splendid species were found by two collectors.

Family LAMELLARIIDÆ.

Genus **LAMELLARIA** Montagu.

Lamellaria Stearnsii Dall.

One shell; soft parts gone. Monks.

Family NATICIDÆ.

Genus **SIGARETUS** Lam.

Sigaretus debilis Gld.

Occasionally washed ashore in the winter with the soft parts gone. One fine shell, with part of the epidermis remaining, was collected by Miss Monks, on Rattlesnake Island.

Genus **NATICA** Lam.

Subgenus LUNATIA Gray.

Natica (Lunatia) Lewisii Gld.

Not often found with the animal in them. Largest ones washed ashore in the bay and at Catalina Island.

Subgenus NEVERITA RISSO.

Natica (Neverita) Recluziana Petit.

Plentiful in the sand, at Santa Monica with *Tivela*.

Family TRITONIIDÆ.

Genus **RANELLA** Lam.

Ranella californica Hds.

Occasionally washed ashore. Often brought in by fishermen.

Family MITRIDÆ.

Genus **MITRA** Lam.

Mitra maura Swains.

Not plentiful, dead. Two or three have been found alive.

Family MARGINELLIDÆ.

Genus **MARGINELLA** Lam.

Marginella Jewettii Cpr. Pl. XIX, fig. 6.

San Pedro, Jewett in U. S. Nat. Museum.

Marginella pyriformis Cpr. Pl. XX, fig. 5.

One or two. (C. T. S.)

Marginella regularis Cpr.

One empty shell. (C. T. S.)

Section VOLVARINA Hinds.

Marginella (Volvarina) varia Sby.

Under stones; rare. Common at Catalina.

Family OLIVIDÆ.

Genus **OLIVELLA** Swainson.

Olivella biplicata Sby.

In the sand near Dead Man's Island. Dead shells not uncommon in the bay.

Olivella biplicata var. **alba.**

Seldom found.

Olivella biplicata var. **brunnea.**

This brown variety is rare, and not found living. Dr. Cooper says *O. biplicata* "varies in color from black through brown, purple, gray and pink to white."

Olivella intorta Cpr. Pl. XIX, fig. 9.

Santa Cruz to Lower California, U. S. Nat. Museum.

Olivella bætica Cpr. Pl. XIX, fig. 7.

In the sand in both bays, although not plentiful.

Family NASSIDÆ.

Genus **NASSA** Lam.

Nassa fossata Gld.

Adults seldom collected.

Nassa insculpta Cpr. Pl. XXIII, fig. 6.

Three; Catalina Island. (J. G. C.) Not uncommon at 16 fathoms depth. Fossil in Pleistocene.

Nassa mendica Gld.

Three; Catalina Island. Rare, and not found alive at San Pedro. (R. E. C. S.)

Nassa mendica var. **Cooperi** Fbs.

Alive at Catalina. Fossil at San Pedro. (R. E. C. S.)

Nassa mendica var. **elongata.**

This variety is unusually long. (R. E. C. S.)

Nassa perpinguis Hds.

Empty shells plentiful in the drift on the beach.

Nassa tegula Rve.

On mud flats. ("Close to *N. vibex* of the Atlantic." W. H. D.)

Family COLUMBELLIDÆ.

Genus **COLUMBELLA** Lam.

Columbella baccata Gask.

A young dead one. (C. T. S.) Southern fauna.

Columbella (Astyris) carinata Hds.

Not rare; often dead.

Columbella (Astyris) gausapata Gld.

Rarer than *C. carinata.*

Columbella (Astyris) tuberosa Cpr. Pl. xx, fig. 6.

Two or three dead shells. *Amycla* of Carpenter.

Columbella (Anachis) penicillata Cpr.

Two. (W. H. D.) Southern fauna.

Columbella (Anachis) tincta Cpr.

One dead. "Gulf of California shell." (C. T. S.)

Columbella (Æsopus) chrysalloidea Cpr.

One on San Pedro beach, [Cooper] U. S. Nat. Museum.

Genus **AMPHISSA** Adams.

Amphissa versicolor Dall. Pl. xx, fig. 9.

A few living specimens found. One here figured is rather shorter proportionately than the majority of specimens. (W. H. D.)

Amphissa bicolor Dall. Pl. xx, fig. 4.

Shell small, solid, pale with brown bands and six convex whorls; nucleus eroded in the specimens; suture distinct, not appressed, whorls

full, with 11 to 13 narrow rounded ribs extending nearly from suture to suture; spiral sculpture of numerous flattened strap-like cinguli separated by subequal channeled shallow interspaces; epidermis thin and yellowish; color of shell pale straw color with a brownish base and a brown band extending from the periphery half-way back to the suture; aperture about equal to the spire, the penultimate rib behind it a little swollen; pillar slender, polished white with little callus; canal wide, short, recurved; outer lip simple, slightly reflected; not lirate inside. Longitude of shell, 14.0; of aperture, 7.7; maximum diameter of shell, 8.0 millimeters.

Habitat: Dredged by the U. S. Fish Commission at various places off the coast from Point Sur to San Diego, and in the Santa Barbara channel in depths varying from 124 fathoms at the south to 298 fathoms at the north, over a sandy or muddy bottom.

The operculum is brownish and resembles that of *A. versicolor* Dall. The brown coloration, though generally disposed in bands as described, is variable, and occasionally appears in a zigzag pattern on the pale ground, or generally suffused over the surface, or even maculated, as in *Nitidella*. The apex when perfect is probably moderately acute, but is more or less eroded on all the specimens. (W. H. D.)

Amphissa undata Cpr. Pl. xx, fig. 8.

Plentiful in 16 fathoms mud, off Catalina Island. This was described by Carpenter as *Amycla undata* and for some time confounded by him with *A. versicolor*. The fine series of *A. corrugata* Rve., *undata*, *versicolor*, etc., now in the National Museum, enable the species to be distinctly differentiated. (W. H. D.)

Family MURICIDÆ.

Genus **PURPURA** Brug.

Purpura lima Mart. **var. emarginata** Desh.

This shell, and two or three varieties of *P. lima*, have been reported from Laguna Beach, Orange County. I have not seen, nor heard of, a recent *Purpura* in Los Angeles County. That it should be found living in the county south of us and in Ventura County north of us, yet not collected here, is certainly noticeable.

Genus **MONOCEROS** Lam. (*Acanthina* F. de Waldheim).

Monoceros engonatum Conr.

Plentiful on the rocks at Rattlesnake Island.

Monoceros engonatum var. **spiratum** Blainv.

A few with the type.

Genus **OCINEBRA** Leach.

Ocinebra circumtexta Stearns. Pl. xx, fig. 2.

Not rare under stones at Portuguese Bend.

Ocinebra circumtexta var.

Three or four, without bands. (R. E. C. S.)

Ocinebra foveolata Hds.

One. (W. H. D.) Trowbridge. Southern fauna.

Ocinebra foveolata var.?

Two. "A variety, probably." (W. H. D.) Trowbridge.

Ocinebra gracillima Stearns.

A few at Point Fermin. (R. E. C. S.)

Ocinebra interfossa Cpr.

Three or four sea-worn examples.

Ocinebra subangulata Stearns.

Two or three shells found. (J. G. C.)

Ocinebra Poulsoni Nutt.

Often inhabited by crabs.

Ocinebra lurida Cpr. Pl. xx, fig. 7.

San Pedro, U. S. Nat. Museum.

Ocinebra lurida var. **munda** Cpr. Pl. xx, fig. 3.

Catalina Island. (W. H. D.)

Genus **PTERORHYTIS** Conrad.

Pterorhytis Nuttalli Conr. (*Cerostoma Nuttalli*, of authors).

Not rare in rock pools; often inhabited by crabs. Some shells are dingy-white, others a reddish-brown color. The name *Cerostoma* is preoccupied. The name *Pterorhytis* was substituted for it by Conrad afterwards. (W. H. D.)

Pterorhytis trialatus Sby. (*Murex trialatus* Sby.).

Have seen three good examples, one found by a Mexican. Shells rare, and usually badly sea-worn.

Genus **PTERONOTUS** Swainson.

Pteronotus festivus Hds.

In tide pools, often inhabited by crabs.

Genus **MURICIDEA** Swainson.

Muricidea barbarensis Gabb.

One dead example. Mrs. Emma King.

Muricidea incisa Brod.

Dead shells common at Catalina; live ones not often collected. Rare in the bay. Alive at Laguna Beach, Orange County.

Genus **CHORUS** Gray.

Chorus Belcheri Hds.

Occasionally found alive in the spring. Often brought in by fishermen. Three young specimens collected at Catalina Island were very thick for their size.

Genus **TROPHON** Montfort.

Subgenus BOREOTROPHON Fischer.

Trophon (Boreotrophon) triangulatus Cpr.

Two or three dead shells. One splendid specimen, found at San Pedro by Miss Hale, and now in the National Museum, is figured in Proc. U. S. Nat. Mus., Vol. XIV, Pl. V, Figs. 1, 3, and 6, 1891.

Family BUCCINIDÆ.

Genus **CHRYSODOMUS** Swainson.

Section **KELLETTIA** Bayle.

Chrysodomus (Kellettia) Kelletti, Fbs. (*Siphonalia* of Carpenter, not of Adams).

Dead shells rare. Live ones brought in by fishermen. Dredged alive in Catalina Harbor. (W. H. D.) The original *Siphonalia* is identical with the much earlier *Strepsidura* of Swainson, but there is no reason to suppose that *Kellettia* belongs to that group. (W. H. D.)

Genus **MACRON** Adams.

Macron lividus A. Adams.

Living at low water on Catalina Island and Laguna Beach.

Family FASCIOLARIIDÆ.

Genus **FUSUS** Lam.

Fusus barbarensis Trask.

Some fine fossil shells have been found in soft rock at Dead Man's Island. "Two living specimens from Catalina Island are now in the National Museum. Probably the adult of the San Pedro fossil described in 1855, by Dr. Trask, as *F. barbarensis*. Similar to, though not identical with, *F. Burnsii* Dall, from the Virginia Miocene." (W. H. D.) One fossil shell found in San Pedro Bay, by Mr. George Gillette, measured 4½ inches in length.

Fusus Kobelti Dall.

Live shells not often washed ashore at Catalina. Dead examples frequently found on the island. Rare at San Pedro.

Fusus luteopictus Dall. Pl. xx, fig. 1.

Four, all dead, but three in good condition. (W. H. D.)

CEPHALOPODA.

Family ARGONAUTIDÆ.

Genus **ARGONAUTA** Linn.

Argonauta pacifica Dall.

Several shells were washed ashore at Catalina Island this year.

Family OCTOPODIDÆ.

Genus **OCTOPUS** Lam.

Octopus punctatus Gabb.

Two or three have been noted. One animal measured over 39 inches across.

SUPPLEMENTARY LIST OF RECENT MOLLUSCA, NOT LATELY FOUND.

Twenty-five years ago, Dr. J. G. Cooper collected shells at San Pedro and vicinity, dredging especially about Catalina Island. He afterwards, in 1867, published his "Geographical Catalogue of the Mollusks found West of the Rocky Mountains," in which this information was embodied. Dr. Cooper has kindly furnished me with a list of shells found in and near San Pedro Bay at that time. In 1873, Mr. W. H. Dall dredged extensively in and near Catalina Harbor, adding a number of species to the fauna. Not wishing to duplicate any names already on my list, I only add a list of such marine forms as have not

been collected during the past two years, many of which being native to Catalina are likely to be found in the bay. For convenience of reference these are arranged alphabetically. Those marked with an asterisk were obtained at San Pedro, the others are from Catalina Island.

Astarte fluctuata, Cpr.
Acanthochiton avicula, Cpr.
**Amphithalamus lacunatus*, Cpr.
Barbatia gradata Sby.
Barleeia haliotiophila, Cpr.
Barleeia subtenuis, Cpr.
Bittium armillatum, Cpr.
Cæcum californicum, Dall.
**Cerithiopsis assimilata*, C. B. Ad.
**Cerithiopsis columna*, Cpr.
?Chlorostoma pulligo Mart.†
**Chrysallida pumila* Cpr.
Clathurella constricta, Gabb.
Clathurella crystallina, Gabb.
Crenella decussata, Mont.
Cryptodon flexuosus, Mont.
Cyathodonta undulata, Conr.
Cythna albida, Cpr.
Daphnella clathrata, Gabb.
**Diala acuta*, Cpr.
**Diala marmorea*, Cpr.
Dunkeria laminata, Cpr.
Entodesma inflata, Conr.
**Eulima compacta* Cpr.
Gibbula optabilis Cpr.
Isapis obtusa Cpr.
Kennerlyia bicarinata, Cpr.
Lepidopleurus scabricostatus, Cpr.
Lepidopleurus pectinatus, Cpr.
Limatula subauriculata, Mont.
Laqueus californicus, Koch.
Lucina tenuisculpta, Cpr.
Macoma inquinata Desh.
Martesia intercalata, Cpr.
Mytilimeria Nuttallii, Conr.
Opalia retiporosa, Cpr.
Plectodon scaber, Cpr.
Psephis Lordi, Baird.
Psephis salmonea, Cpr.
Puncturella Cooperi, Cpr.
Rissoina interfossa, Cpr.
**Scala crebricostata* Cpr.
Semele incongrua, Cpr.
**Styliferina turrita* Cpr.
Terebratella occidentalis Dall.
**Xylotrya setacea* Tryon.

SUPPLEMENTARY NOTE.

Since the time when this list was finished and submitted for publication, the collectors of Los Angeles County have not been idle and their work has borne abundant fruit. The species added have been incorporated in the proofs, but a few words seem appropriate in regard to some of the finds. Miss Shepard, to whose successful energy in collecting I am greatly indebted for the completeness of this list, has continued her work with exceptionally good results; Miss Monks has also been remarkably successful, especially in obtaining a fine series of the fossil forms of *Fusus* from the blue clay of Dead Man's Island and of the recent *Scala bellastriata* and other interesting forms. The living specimen of *Pecten floridus*, referred to in the text, was obtained by Mrs. Garlick at Timms Point and is now in the possession of Mr. Orcutt, of San Diego. Mrs. Redding, of Long Beach, has obtained several additional specimens of the *Periploma discus*. *Pleurotoma* (*Dolichotoma*) *Carpenteriana* var. *Tryoniana* Gabb has been collected at San Pedro by Miss Monks; who has also found specimens of *Trophon triangulatus*, of which fine specimens exist in the State collection at Berkeley, where they had till recently been confounded with *Chorus Belcheri* junior. It appears that the number of varices in this species is some-

† San Pedro. Perhaps *C. Montereyensis* worn.

times larger than in the figured type. Among the shells collected by Mr. Arnold is a very young specimen of *Avicula*, which goes to confirm the nativity of the questionable specimen of *A. peruviana* before enumerated. A remarkable find of several hundred *Nassa fossata*, and another of especially fine *Cardium substriatum*, both at San Pedro, are among the interesting data of our later conchological notes.

Los Angeles, May, 1892.

EXPLANATION OF PLATES.

NOTE.—The figures being enlarged or reduced from the actual size of the specimens, the actual largest diameter of the specimen, as seen in the figure, is mentioned in millimeters, of which 1 is equal to $\frac{1}{25}$ of an inch. The Museum registration number of the specimen is also added.

PLATE XIX.

Page.

Fig. 1. *Mitromorpha filosa* Cpr., 46418, 8 millimeters 208
2. *Halistylus pupoideus* Cpr., 14824, 6 millimeters 202
3. *Mitromorpha aspera* Cpr., 46416, 5 millimeters 208
4. Operculum of *Pachypoma inæquale* Martyn (= P. gibberosum Cpr.), outside view, 25.5 millimeters 199
5. The same, inside view, 25.5 millimeters 199
6. *Marginella Jewettii* Cpr., 56224, 5.6 millimeters 212
7. *Olivella baetica* Cpr., 47198, 18 millimeters 212
8. *Calliostoma tricolor* Gabb, 59800, basal diameter 15 millimeters 201
9. *Olivella intorta* Cpr., 47202, 15 millimeters. In this figure, as well as in figure 7, the color pattern is ignored 212

PLATE XX.

Fig. 1. *Fusus luteopictus* Dall, 32350, 17.5 millimeters; the color pattern is ignored 217
2. *Ocinebra circumtexta* Stearns, short variety, 46694, 22 millimeters 215
3. *Ocinebra lurida* Midd. var. *munda* Cpr., 46708, 16 millimeters 215
4. *Amphissa bicolor* Dall, 106877, 14 millimeters 213
5. *Marginella* (*Volutella*) *pyriformis* Cpr., type specimen; 14950, 2.3 millimeters 212
6. *Astyris tuberosa* Cpr., type specimen; 11833, 9 millimeters; color ignored 213
7. *Ocinebra lurida* Middendorf, typical form; 28473, 25 millimeters 215
8. *Amphissa undata* Cpr., typical; 56749, 12 millimeters; the color is ignored in this and the next figure 214
9. *Amphissa versicolor* Dall, short variety, 12277, 18 millimeters 213

PLATE XXI.

Fig. 1. *Ovula* (*deflexa* Sby. var.) *barbarensis* Dall, from Miss Monk's specimen; 25 millimeters 206
2. *Vitrinella?* (*Adeorbis?*) *Williamsoni* Dall, 106856, front view; lat. 5.5 millimeters 202
3. The same, from below; 5.5 millimeters 202
4. *Bittium quadrifilatum* Cpr., 32218, 12 millimeters 205
5. *Calliostoma splendens* Cpr., 60671, basal diameter 5 millimeters 201
6. *Chlorostoma funebrale* A. Adams, variety *subapertum* Cpr., basal view of type specimen showing umbilical pit; 30 millimeters, 123496 200
7. *Chlorostoma funebrale* A. Adams, ordinary form; 30 millimeters, 59758 200
8. *Chlorostoma brunneum* Phil., 60056, 28 millimeters 200

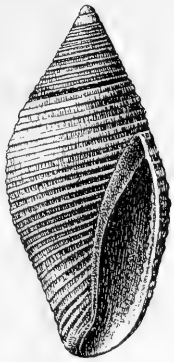
PLATE XXII.

Page.

Fig. 1. *Calliostoma costatum* Martyn, 102147, 27 millimeters, the color pattern ignored 201
2. *Calliostoma annulatum* Martyn, 32481, alt. 30 millimeters, color pattern ignored 201
3. *Calliostoma gemmulatum* Cpr., 32501, alt. 17.5 millimeters, color pattern indicated 201
4. *Solariella cidaris* A. Adams, 122574, alt. 28 millimeters 202
5. *Calliostoma gloriosum* Dall, 59963; alt. 22 millimeters; color pattern ignored 201
6. *Calliostoma canaliculatum* Martyn, 32495; basal diameter 36 millimeters 201

PLATE XXIII.

Fig. 1. *Pachypoma inæquale* Martyn, 13580, 47 millimeters 199
2. *Cancellaria Cooperi* Gabb, 106860, 57 millimeters 211
3. *Pachypoma inæquale* Martyn, depressed variety, 13580, basal diam. 43 millimeters 199
4. *Lioconcha Newcombiana* Gabb, 25 millimeters 87
5. *Pachypoma inæquale* Martyn, elevated form, basal diameter 47 millimeters 199
6. *Nassa insculpta* Cpr., type specimen, 46625; 18 millimeters 212



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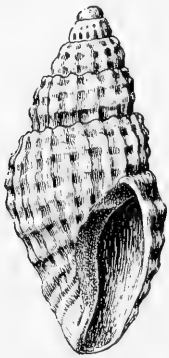

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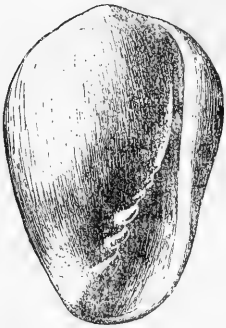

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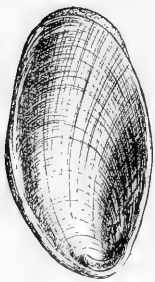

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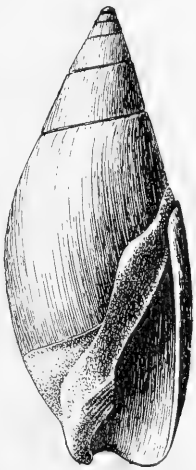

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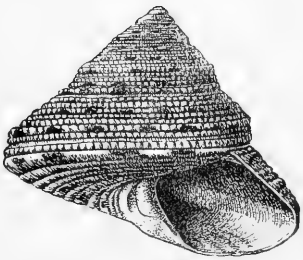

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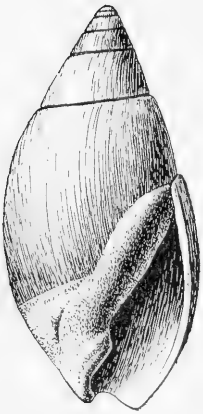

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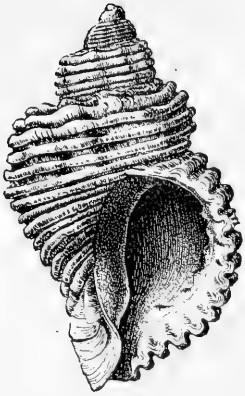

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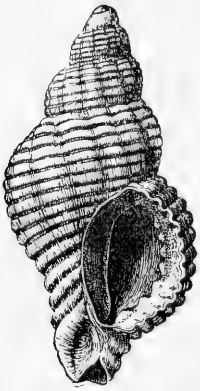

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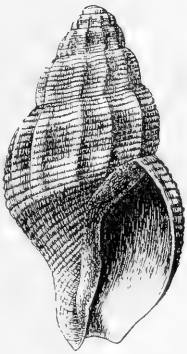

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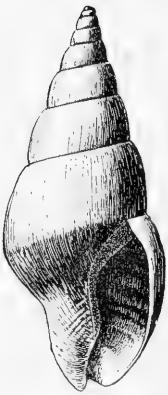

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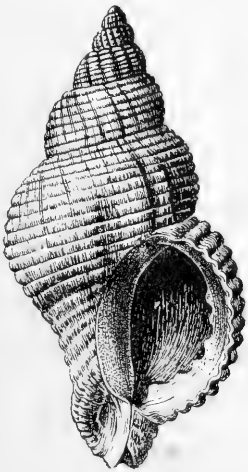

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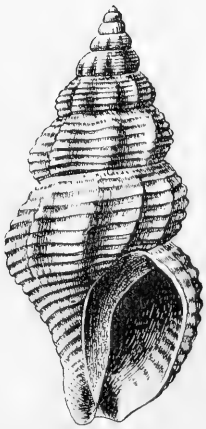

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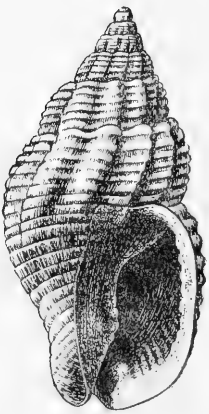

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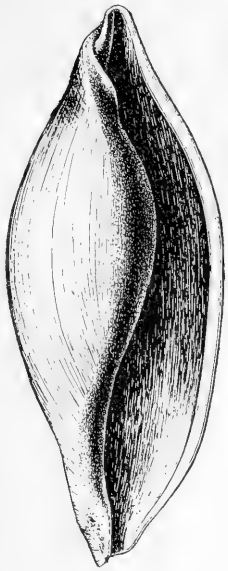

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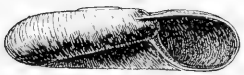

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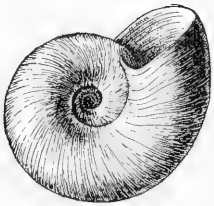

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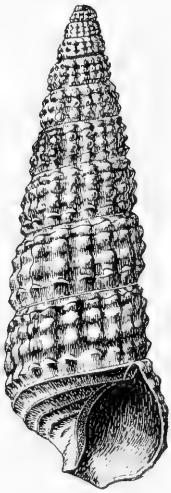

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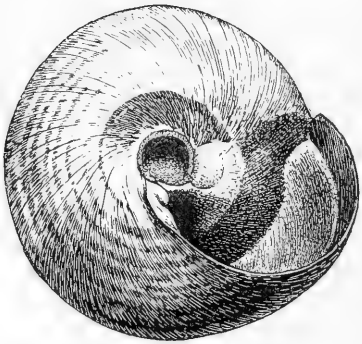

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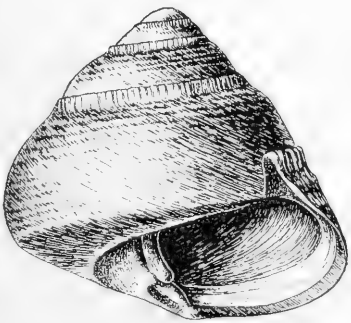

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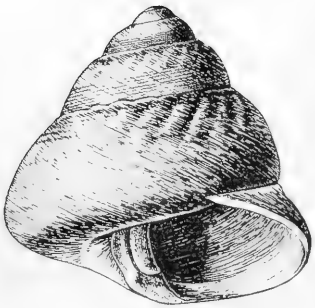

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SHELLS OF SAN PEDRO BAY.

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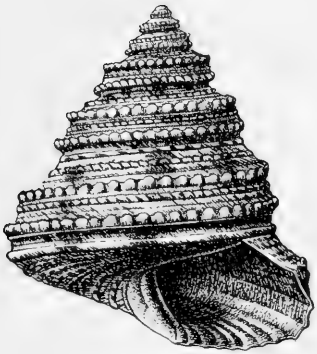

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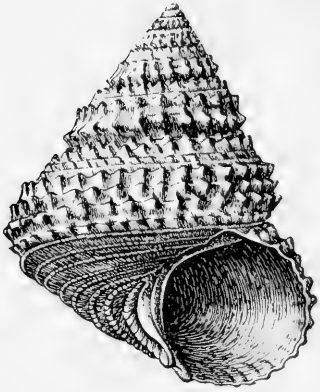

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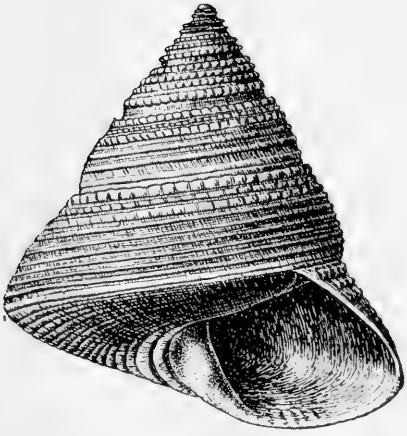

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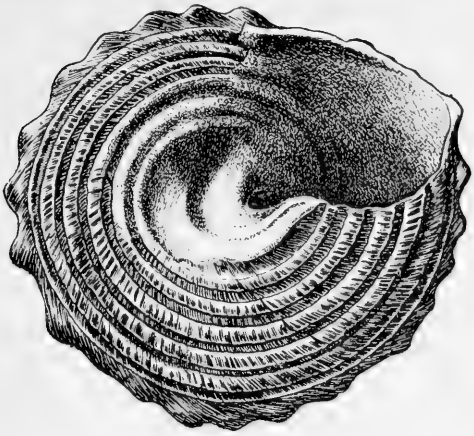
SHELLS OF SAN PEDRO BAY.



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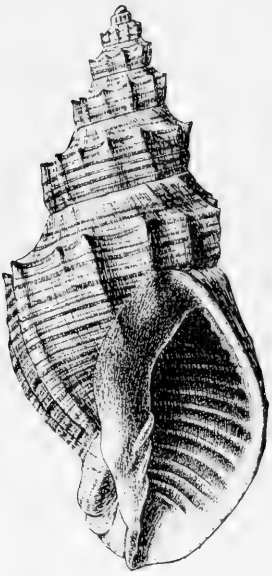

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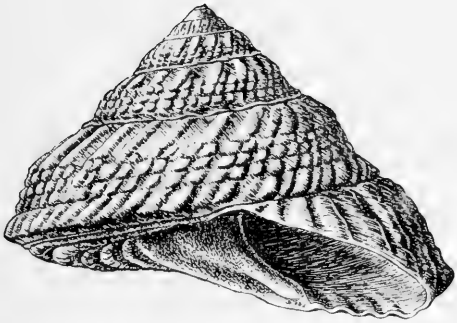

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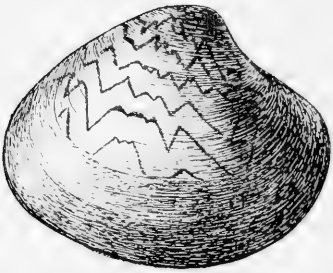

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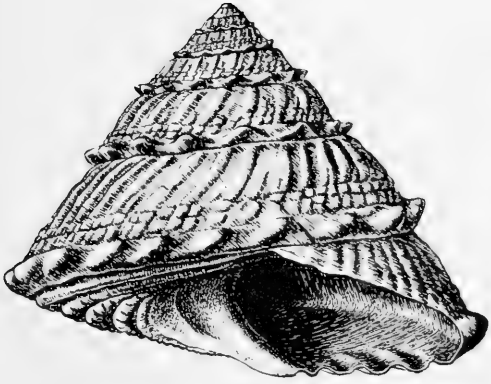

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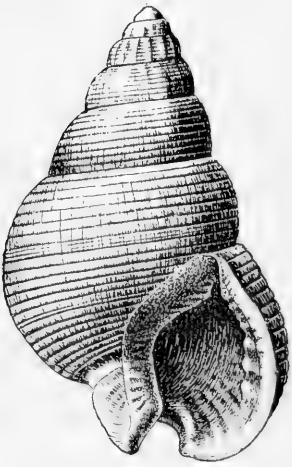


6

SHELLS OF SAN PEDRO BAY.

CHINESE RELICS IN ALASKA

BY

LIEUTENANT T. DIX BOLLES, U. S. N.

(With Plate XXIV.)

In a collection of ethnological objects from southeastern Alaska, donated to the National Museum in 1883–'85, there is a wooden mask which has for its eyes two large bronze Chinese Temple coins; so identified by Dr. D. B. McCartee.

The grave from which it was taken is located near the Chilcat Village at the mouth of the Chilcat River, Alaska, where stand a row of six grave-houses on a narrow strip of land close to the river, with a swamp back of them. Four of these graves were almost in ruins, but had evidently not been touched when we opened them. From the one in which the mask was found we got very little, its contents having nearly all rotted completely away, the mask in question being better preserved than the rest by a loose cedar board which protected it from the rain which leaked through in other places. The mask is skillfully carved from cedar wood and painted in the usual grotesque manner, but with strictly native colors. A sparse fringe of human hair partly rotted is inserted above the forehead. The wide gaping mouth is set with a double row of opercula, for teeth. Upon a casual inspection this mask does not show age, but, examined more closely, the wood is seen to be affected with dry rot, while the surface seems to have been protected by the paint which was probably mixed with fish oil.

The grave in which this mask was found was pointed out to me as being old, and that of a medicine man who had flourished more than two hundred years ago, six successors having filled this office; each one living to a good old age. Careful questioning failed to bring any other answer. When the coins were shown to the native Chilcats they could not remember having ever seen such objects before.

Knowing that at the date I made my collections the Indians themselves never entered or took anything out of graves, I am free to confess that I see no other possible conclusion to draw than that these coins were obtained two hundred years ago, and the natural surmise is that they came from a junk driven on the coast, Chinese most likely, as the Japanese would probably not have two such coins. To those who doubt the advent of junks on the West Coast at this early date, these facts will probably not be satisfactory, but it will be necessary for them to break down by direct evidence such a strong plea.

ALASKAN MASK WITH CHINESE MEDALS.

CORYSTOID CRABS OF THE GENERA TELMESSUS AND ERIMACRUS.

BY

JAMES E. BENEDICT,

Assistant Curator of the Department of Marine Invertebrates.

(With Plates XXV–XXVII.)

This article is based on specimens from Mr. William H. Dall's Alaskan collection obtained from 1871 to 1874, and on the recent large collections made by the U. S. Fish Commission steamer *Albatross*. The list of localities will show that the Museum is indebted to others for additional specimens. One of the objects of this paper is to call attention to these peculiar crabs, and to invite interest in their habits and life history, of which I believe little is known. The figures were drawn by Mr. A. E. McConnell.

The following key sufficiently indicates the species of the two genera:

a. Carapace broader than long..... *Telmessus.*
1. Lateral teeth triangular..... *cheiragonus.*
2. Lateral teeth spiniform..... *acutidens.*
b. Carapace longer than broad..... *Erimacrus isenbeckii.*

Telmessus White.

Cancer Tilesius, Mém. de l'Acad. de St. Pétersbourg, Vol. v, p. 347, 1815.
Telmessus White, Ann. & Mag. of Nat. Hist., Vol. XVII, p. 497, 1846.
Platycorystes Brandt, Bulletin Physico-Mathématique de l'Académie de St. Pétersbourg, Vol. VII, p. 179, 1848; also Middendorff's Sibirische Reise, Band II, Theil I, p. 85, 1851.
Cheiragonus Brandt, Middendorff's Sibirische Reise, Band II, Theil I, p. 147, 1851.
Telmessus Dana, U. S. Exploring Expedition, Crustacea, Vol. I, p. 303, 1852.

Carapace broader than long, pentagonal. Front divided into three lobes; median lobe cut into four teeth or denticles; lateral lobes forming the inner angles of the eyes. Epistome with triangular point extending upwards on the median line between the antennulæ. Basal article of the antenna wide, short, flattened; a wing-like projection fills the hiatus of the eye. Sternum of the female thickened and sculptured around the genital openings. Abdomen of the female deeply concave between the genital openings, leaving them fully exposed. Chelipeds short; ambulatory legs moderately long.

This genus contains, as far as known, but two species; one, *T. acutidens* (Stimpson), is common in northern Japan; another and closely related species, *T. cheiragonus* (Tilesius), ranges from Oregon to St.

Michaels Island, Alaska, and perhaps much farther north; westward along the Aleutian Islands, the Commander Islands, and formerly and probably yet along the coast of Siberia.

Telmessus cheiragonus (Tilesius).

Plates XXV and XXVI; figs. 2, 3, and 4.

"Cancer adsperso setosus vel Hippocarcinoides *Stelleri* Mscrpt. No. III. Alio loco *Stellero* Cancer pilosus et Cancer auritus dictus (1741. Awatschae)" teste Tilerius.

Cancer cheiragonus Tilesius, Mém. de l'Acad. de St. Pétersbourg, Vol. V, p. 347, 1815. (Tab. VII, Fig. 1, is referred to in the text. There are no plates in the Smithsonian copy of the work.)

Telmessus serratus White, Ann. & Mag. of Nat. Hist., Vol. XVII, p. 497, 1846; also Voyage of Samarang, Crustacea, p. 14, 1848.

Platycorystes ambiguus Brandt, Bulletin Physico-Mathématique de l'Académie de St. Pétersbourg, Vol. VII, p. 179, 1848.

Platycorystes cheiragonus Brandt, Middendorff's Sibirische Reise, Band II, Theil I, p. 85, 1851.

Cheiragonus hippocarcinoides Brandt, Middendorff's Sibirische Reise, Band II, Theil I, p. 147, 1851.

Telmessus serratus Dana, U. S. Exploring Expedition, Crustacea, Vol. I, p. 303, Pl. 18, Fig. 8, 1852.

Cheiragonus hippocarcinoides Stimpson, Crustacea and Echinodermata of the Pacific Shores of North America, Boston Journal of Nat. Hist., Vol. VI, p. 465, 1857.

Telmessus serratus and *T. cheiragonus* Miers, Proc. Zoöl. Soc. of London for 1879, p. 36.

Telmessus serratus S. I. Smith, Geological Survey of Canada, Report for 1878 and 1879, p. 208 B, 1880.

Teeth or denticles of the median lobe of the front often wanting in old worn specimens; lateral lobes triangular, forming the inner angles of the eyes. Carapace deeply areolated. Lateral teeth six in number including the angles of the eyes the anterior three with two denticles on the anterior margin of each. The points of the teeth are bent forward and are on a line with the denticles. The fourth tooth forms the lateral angle of the carapace, and has four denticles on the anterior margin, one close to the point of the tooth; then a space, followed by three denticles evenly placed. The posterior teeth are without denticles. The surface of the carapace is set with large granules, in the posterior region forming lines. From these granules arise numerous bristles of even length, which bend forward and are enlarged at the points. (See Fig. 4.)

The merus of the chelipeds has three nearly equal surfaces. The inner margin of the carpus is produced into a large, triangular, sharp-pointed tooth; a deep groove runs along its outer distal margin; the outer surface is spiny. The outer surface of the palm is traversed by four rows of tubercles; on the upper surface there are two or three spines on the inner margin, and a row of tubercles on the outer margin. The fingers are deeply grooved; the prehensile edges are heavily armed with tubercular teeth. On the ambulatory legs are lines of granules bearing coarse bristles. All of the joints are much compressed. The dactyls have short horny tips; on each side is a wide groove, and also a narrow one. The upper margin is grooved; on each

side of this groove are double rows of sharp spiny granules; the space between is filled with short, stout, curved bristles. The lower margin of the dactyls has one double row of these granules; the space between is also set with sharp bristles.

The numerous specimens of this species in the collection are without doubt identical with *T. serratus* of White. White's figure represents an imperfect male, the front is not well defined, and the greater part of the hair is gone, yet it is a graphic picture of some individual specimens.

Dana's figures are not characteristic, representing as they do an immature female. A female in the collection, with an undeveloped abdomen, might almost have served for the original of the figures, except that the inner angle of the eye is much straighter than in his figure.

The identification of this species with the *Cancer cheiragonus* of Tilesius is not quite so satisfactory, but, all things considered, the evidence seems to be, if not conclusive, at least strong.

Brandt described *Platycorystes ambiguus* in 1848, and in 1851 determined this to be identical with *Cancer cheiragonus* of Tilesius; afterwards, with White's description and figures before him, identified White's species with his. The peculiar short, coarse hair of even length with which this crab is ordinarily well covered, not unlikely suggested the name *Hippocarcinoides* to Steller at one time and *Cancer pilosus* at another, while the arched and produced inner angle of the eye as seen from above suggested the name of *Cancer auritus*.

The specimens in the collection, over one hundred and fifty in number, came from Oregon and north along the Alaskan coast, from several of the Aleutian Islands, and one from Bering Island, near the coast of Siberia. If a species liable to be confounded with *cheiragonus* existed in this locality, it would probably be represented by one or more specimens. Steller's and Brandt's specimens were obtained in the same region.

The finest lot from one locality were collected by Dr. T. H. Streets, U. S. Navy, at Kasa-an Bay, Prince of Wales Island, southeastern Alaska; ten specimens in all; five males, of which the smallest is 49 millimeters in length by 65 in breadth, the largest 63 millimeters in length by 82 in breadth; five females, of which the smallest is 45 by 58, millimeters; the largest, 57 by 74, millimeters.

The reproductive openings in the females of this genus are placed outside of, or rather out from under, the abdomen. At these openings the sternum is thickened and very solid. The opening itself is funnel-shaped, spreading out into an ear-like depression, the sides of which are thickened and elevated above the surrounding surface of the sternum. In the immature female the sixth segment of the abdomen has slightly concave edges. In the mature female the abdomen has expanded greatly, except the seventh segment and two-thirds of the sixth, which in an individual case measures 16 millimeters near the articulation with the

fifth segment, in the middle 10 millimeters, and across the distal end 10.5 millimeters. This leaves the genital opening nearly on the axis of a semicircle, and fully exposed.

The females in the lot collected by Dr. Streets have these genital openings stopped up with a ragged looking plug, which more or less completely fills up the ear-like external part of these organs and even bulges out from them quite prominently. In most cases a tough, flat membrane, ragged and worn at the end, projects a little beyond the mass. Dissection shows that the plug extends to the point where the duct widens out into the seminal receptacle, where it terminates in a thin membranous funnel. What are these plugs, and what purpose do they serve? are questions which naturally arise. Are they the male organs? From underneath the head of the plug to the funnel-shaped ending the duct is exactly the same shape and size as the male organ. A section shows it to have the same structure. If the male organ is pushed in as far as it will go and detached, the flattened basal portion must project considerably on the outside. This portion would soon become broken and frayed out at the end; this could easily happen, as the strong armature of the genital openings would hold them without injury to the animal. The agitation necessary to accomplish this may aid the secretion of the substance of the head of the plug which so perfectly conforms to the parts by which it is held. A section of this enlarged part shows a continuation of the tougher frayed-out portion through the secretion. The male organ would not only stand out from the sternum beyond the plug, but it would extend beyond the inner end unless broken off or dissolved. The terminal portion of this organ is thin and flexible and of a different color from the posterior four-fifths. The organ itself is easily detached from the animal. Its loss would not necessarily be of great importance, as it would probably be quickly reproduced.

Opposed to the supposition that this is the male organ is the fact that all of the males in the collection are perfect. There are no females with eggs in the collection, and but one besides those collected by Dr. Streets in the above condition.

This species is said to be used as an article of food by the natives of the Aleutian Islands. Wosnesenski (Sibirische Reise) says, however, that the species was not highly regarded as food, as its flesh was very soft. Mr. William Palmer opened the stomachs of from eight to ten fur seals on the killing grounds of St. Paul Island, and though their stomachs were nearly empty, both he and Mr. H. W. Elliott were satisfied that the contents remaining in one were shells of crabs of this species. The natives believe it to be eaten by this seal.

Length of the carapace of a large specimen, 83 millimeters; width, 102 millimeters; extent of ambulatory legs, 330 millimeters.

RECORD OF SPECIMENS.

The U. S. Fish Commission steamer *Albatross* obtained this species at the following localities:

Station.	Depth.	Lat. N.	Long. W.	Mus. No.
	Fath.	° ′ ″	° ′ ″	
3233	7¼	58 23 45	157 42 45	15997
3242	11	58 44 30	160 08 45	15998
3243	4½	58 45 10	160 28 00	15999
3244	4½	58 37 20	161 05 00	16000
3245	11½	58 31 20	161 13 00	16001
3247	17	58 40 45	162 08 30	16002

Unalaska, July 23, 1888 (15576).
Unalaska, May 24, 1890 (16004).
Herendeen Bay, July 5, 1890 (16003).
Old Harbor, Kadiak, August 11, 1888 (15574).
Beaver Harbor, B. C. (15575).

Mr. William H. Dall obtained specimens as follows:

Hagemeister Strait, 8 to 15 fathoms (13117).
Hagemeister Island, beach (14819).
Chichagoff Harbor, Attu, 5 to 7 fathoms (14818).
Nazan Bay, Atka Island, 10 to 15 fathoms (14817).
Iliuliuk, Unalaska, 5 to 15 fathoms (13115).
Iliuliuk, Unalaska, near beach (12493).
Popoff Strait, 6 fathoms (14813).
Coal Harbor, Unga Island, 3 to 9 fathoms (14812).
Chiniak Bay, Kadiak (12533).
Chajafka Cove, 12 to 14 fathoms (14814).
Chugachik Bay, Cook's Inlet, 20 fathoms (12509).
Refuge Cove, Port Chatham (14815).

At the following localities, specimens were obtained by various collectors:

St. Michaels Island; L. M. Turner, 1874 (3258).

"This specimen was found on the beach after a hard south wind." Mr. Turner was informed by a Malemut woman that "the natives catch them on their fishing lines."

St. Michaels Island; E. W. Nelson, 1878 (2502, 14820).
Iliuliuk; W. G. Harford (2136).
Sitka; L. A. Beardslee, Commander, U. S. Navy (3168).
Kasa-an Bay; Prince of Wales Island; Dr. T. H. Streets, U. S. Navy (14824).
Bering Island, Commander Islands, Siberia; Dr. Leonhard Stejneger, February 1883 (14821).
St. Paul Island, Bering Sea; H. W. Elliott, 1874 (14835).
St. Paul Island, Bering Sea; Wm. Palmer, 1890 (15342, 15343).
Puget Sound; D. S. Jordan, 1880 (3110).
Straits of Fuca (3065).
Port Orchard, Puget Sound; Prof. O. B. Johnson, 1889 (14965).
Victoria, British Columbia; Dr. C. F. Newcombe, 1891, (15790).
North Island, British Columbia; J. G. Swan, August, 1883 (6603).
Port Townsend, Oregon; Dr. Suckley (2058).

Telmessus acutidens (Stimpson).

Plate XXVI, fig. 1.

Cheiragonus acutidens Stimpson, Proc. Acad. Nat. Sci. Phila., p. 40, 1858.
Telmessus acutidens Miers, Proc. Zoöl. Soc. of London, for 1879, p. 36.
Telmessus acutidens S. I. Smith, Geol. Survey of Canada, Report for 1878–'79, p. 208 B, 1880.

The collection contains one male specimen from 8 fathoms, mud bottom, Yokohama, taken by the U. S. S. *Tuscarora* (3388); and 14 males, 8 females, from Japan, H. Loomis (16275).

This species can easily be distinguished from *T. cheiragonus* by the much more slender lateral spines, and by the spine at the posterior base of the long spine, making three postero-lateral spines, while *cheiragonus* has but two. Its outline is not so angular, and it is much more convex than the preceding species. The point of the long lateral spine curves forward but little, while that of *cheiragonus* curves so much that it is naturally counted with the denticles on its anterior edge and base. Not counting the terminal point these denticles number four in *cheiragonus* and five in *acutidens*.

The following description of *Telmessus acutidens* is from Dr. Stimpson's unpublished report upon the Crustacea of the North Pacific Exploring Expedition: (The latin description was printed under the name *Cheiragonus acutidens* Stimpson in Proc. Nat. Sci. Phila., p. 40, 1858.)

"Carapax rather narrow; proportion of length to distance between tips of lateral teeth, 1 : 1.26. Surface covered with setiferous tubercles, mostly transverse, as in other species of the genus. Lateral teeth slender, sharp, the principal or middle one very long; a small intermediate tooth at the base of the principal one behind. Between the teeth and sometimes on their edges there are a few small spiniform denticles. Interantennal front or rostrum with a deep median sinus, and a smaller sinus or excavation at the tip of each fork, as in *C. hippocarcinoides*. Antenna more than one-third as long as the carapax. Feet all squamose or scabrous and setose. Chelopoda somewhat spinous above; hand costate externally, the costæ sharply tuberculated.

"Color in life light brick-red above; paler, inclining to yellowish below. Some specimens are of an orange color, but always dusky. Pincers dark brown. Dimensions of a male: Length of carapax, 1.45; breadth between tips of lateral teeth, 1.83 inch. It grows to a length of 3 inches, but the larger specimens, of which several were collected, were accidentally lost.

"It may be distinguished from *C. hippocarcinoides* as found on the west coast of America, as well as from *Telmessus serratus*, White, by the greater length and acuteness of the lateral teeth, particularly the larger one; also by the existence of a small intermediate tooth behind the large one."

This crab is very common in the Bay of Hakodadi, in northern

Japan. It is commonly taken with the seine on sandy shores, but often occurs on gravelly beaches above low-water mark. In June the young, of half an inch to an inch in length, were much more abundant than adults, and were taken with the dredge in 4 fathoms weedy sand.

In the time of Steller a species of *Cheiragonus* was so abundant in Avatcha Bay (Kamschatka) that it formed a common article of food among the inhabitants. At the present time, however, it has entirely or nearly disappeared, as we did not succeed in obtaining a specimen; nor do the naturalists of Beechey's voyage mention having found it.

ERIMACRUS, gen. nov.

Carapace longer than broad, suboval; median lobe of the front cut into four teeth. Lateral margins arcuate, armed with seven teeth. The genital openings of the female occupy the posterior wall of a deep depression in the sternum, and are not covered by the abdomen, which is not concave on its margins between these openings. Epistome with a straight upper margin. Basal article of antenna stout; a short wing-like extension fills the hiatus of the eye. Chelipeds long; ambulatory legs moderately long, spiny.

Brandt considered this genus, or the species for which it is constructed, to be generically or subgenerically distinct from *Platycorystes*, but unfortunately gave it a name (*Podacanthus*) which had been used by Gray for a genus of Orthoptera. His other name, *Platycorystes*, was based on *Telmessus cheiragonus* as the type; therefore the name is not available.

Erimacrus isenbeckii (Brandt).

Plate XXVI, figs. 5, 6, and 7; plate XXVII.

Platycorystes (Podacanthus) isenbeckii Brandt, Bulletin Physico-Mathématique de l'Acad. de St. Pétersbourg, vol. VII, p. 179, 1848. Also in Middendorff's Sibirische Reise, Band II, Theil I, p. 83, 1851.

Cheiragonus isenbeckii Brandt, in postscript of the last work, p. 147.

Brandt described this species under the heading "Genus vel subgenus *Platycorystes* Sect. B (num subgenus proprium *Podacanthus?*)." The collection contains over forty specimens, all from the Aleutian and seal islands, the habitat given by Brandt, who says that it is much rarer than *cheiragonus*. "Mertens obtained but one, and Wosnesenski only five, in eight years collecting."

Brandt described the front as having four teeth, no doubt counting the spines of the inner angles of the eyes, as in *cheiragonus*, and says the middle pair are conspicuous. A large specimen before me has this appearance; the front is worn or broken until it shows but two central teeth. The young, however, have four small sharp teeth at this place, very closely like those of *cheiragonus;* the central pair are separated by the median sulcus; they are very brittle and in most specimens are broken off, leaving a straight margin between the outer pair broken only by the median sulcus. Afterwards when these latter are broken off, as is the case with the large specimen, the median sulcus divides the pro-

duced front into two large, prominent, blunt teeth. "The lateral margins are armed with seven teeth, of which the four anterior are subequal or a little larger than the first of those remaining."

The carapace is thickly set with spiny tubercles. The merus joints of the four pairs of ambulatory legs have their distal upper margin set with six or seven sharp procurved spines; the lower margins have a double row; the posterior sides of the last pair are tuberculous or spiny; the anterior side of the last pair and the sides of the others are hairy. The carpal, propodal, and dactyl joints have three rows of sharp spines. The hands are nearly equal; a row of spines extends along the upper margin and part way down the movable finger; the outer lower margin has another row; on the outside of the hand there are four rows. The spines of the row which extends from the gape of the fingers to the carpal joint are conspicuously smaller than the others. The fingers are long and pointed and armed with large teeth.

The mature female abdomen is altogether different from that of *cheiragonus*, the sixth article being but slightly concave. The reproductive openings are placed outside of the abdomen, and differ much in shape and a little in position from those of *cheiragonus*. In the latter they are opposite the middle line of the second pair of ambulatory legs; in this species they are on the line between the first and second pairs.

The legs and lower parts of the body are thinly covered with long hair, the carapace with short bristles (see pl. XXVI, fig. 7).

Length of carapace of a large specimen, 110 millimeters; width, 106 millimeters; extent of ambulatory legs, 460 millimeters.

RECORD OF SPECIMENS.

Albatross dredgings, 1890.

Station.	Depth.	Lat. N.	Long. W.	Mus. No.
	Fath.	° ′ ″	° ′ ″	
3222	50	54 20 00	165 30 00	16006
3268	26	55 29 00	163 13 00	16007
3269	16	55 19 00	163 04 30	16008, 16015
3271	25	55 29 15	162 58 00	16009, 16016
3272	31	55 31 40	163 07 00	16017
3275	22	55 44 20	162 17 30	16010
3277	18	55 58 45	161 46 30	16011
3281	36	56 14 00	161 41 15	16018
3289	16	56 44 30	159 16 00	16012
3294	30	57 16 45	159 03 30	16013
3311	85	53 59 36	166 29 43	16014

Mr. William H. Dall obtained specimens as follows:

Kyska Harbor, 6–12 fathoms (14831).

Nazan Bay, Atka, 10–16 fathoms (14828).

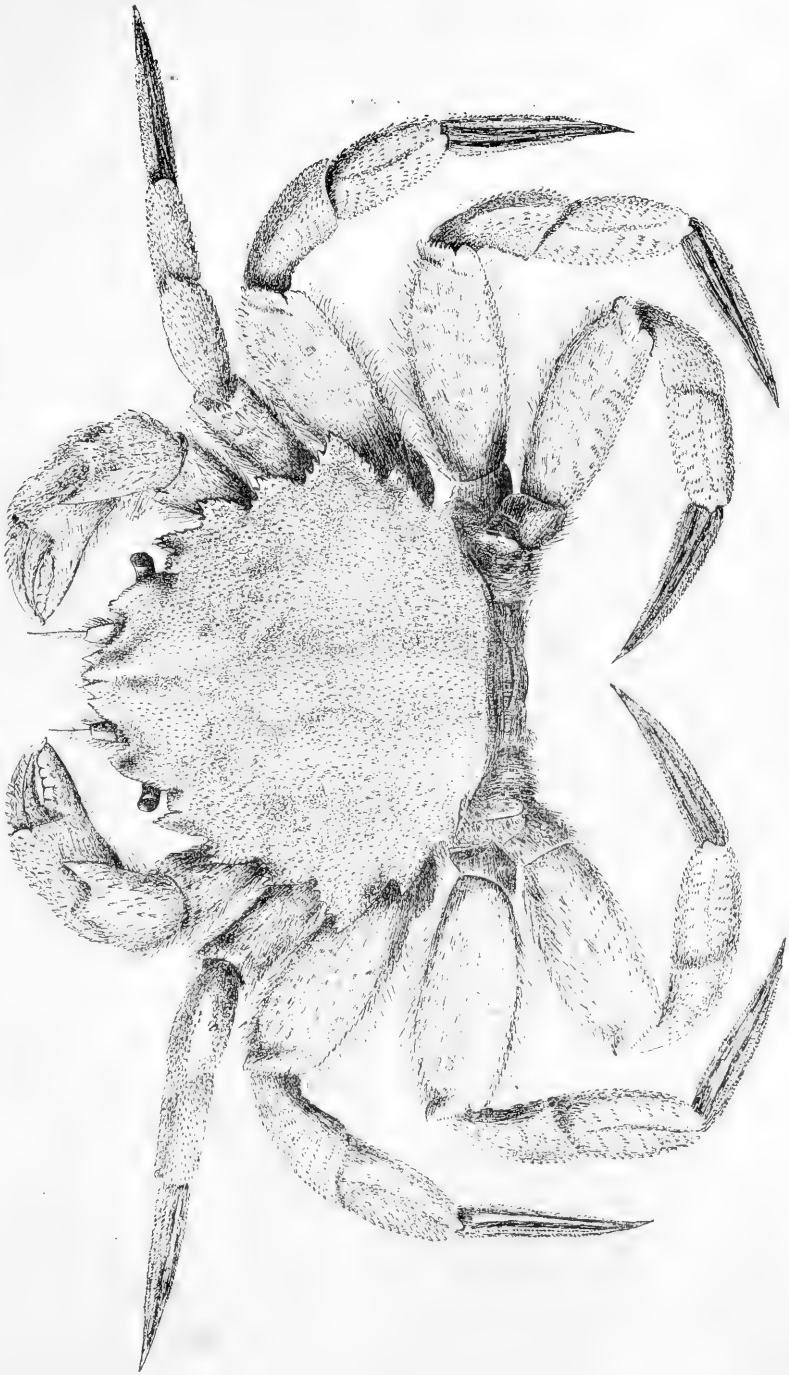
Off Rocky Point, Iliuliuk, Unalaska, 10 fathoms (13141).

Captain's Bay, Unalaska (14832).

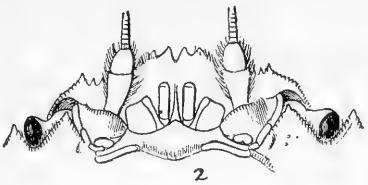
Off Round Island, Coal Harbor, Unga Island, 6–8 fathoms (14830).

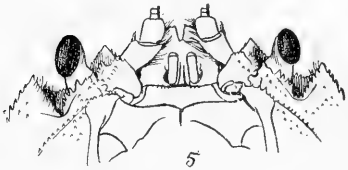
Port Levasheff (14833).

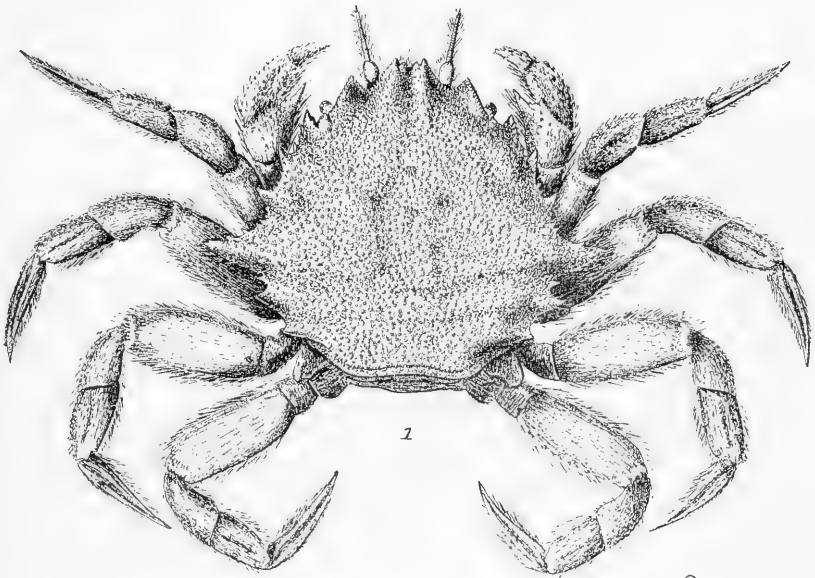
Additional specimens were collected at St. Paul Island, H. W. Elliott, 1872 (14834); and at St. Paul Island, William Palmer, 1890 (15344, 15345).

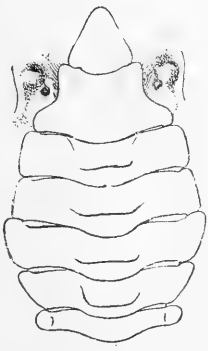


Telmessus cheiragonus (reduced).









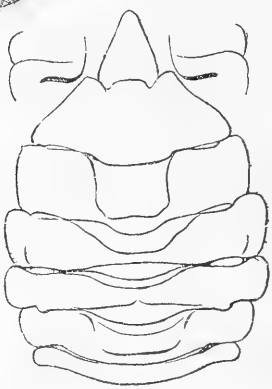
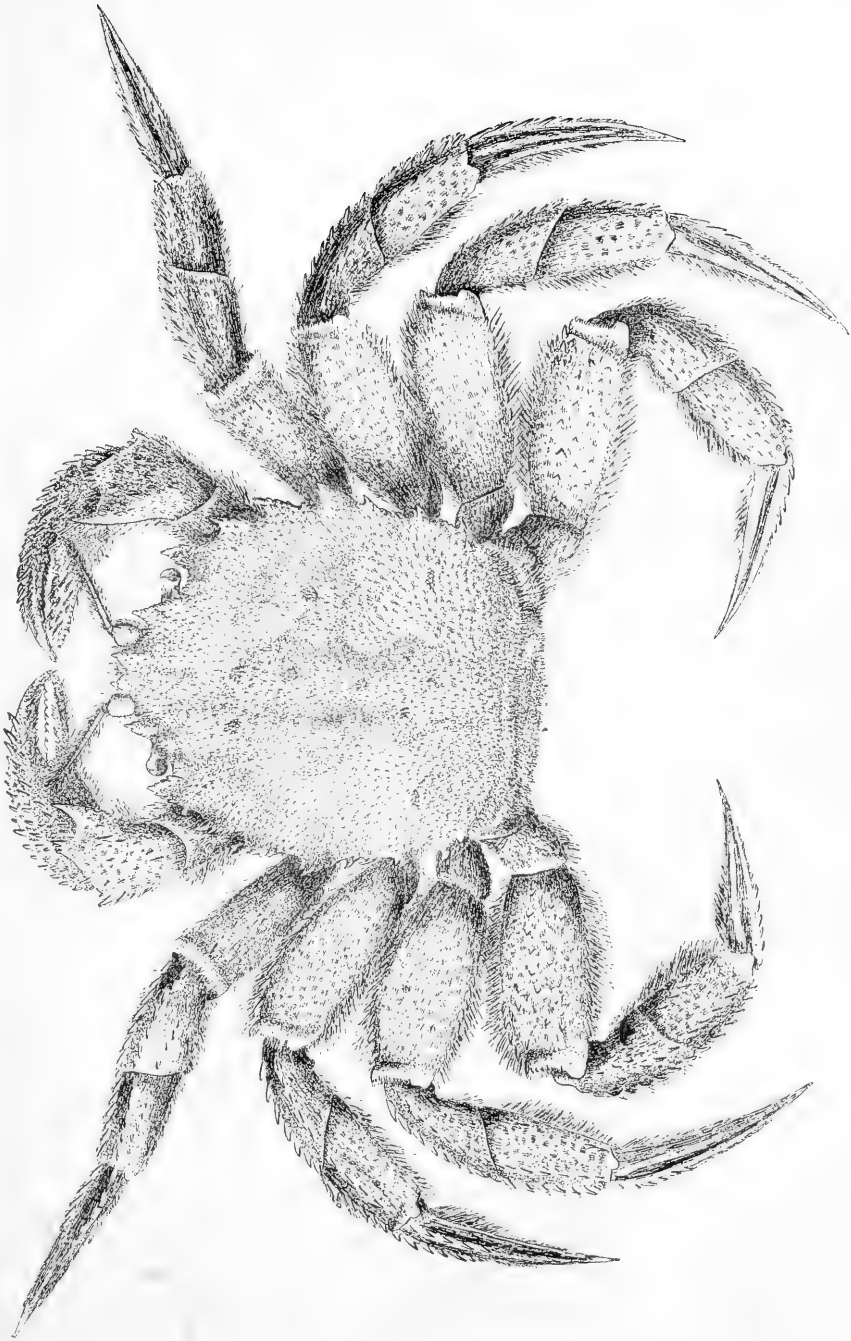


Fig. 1. *Telmessus acutidens.*
Fig. 2. *Telmessus cheiragonus*, epistome.
Fig. 3. *Telmessus cheiragonus*, female abdomen and sternum.
Fig. 4. *Telmessus cheiragonus*, bristle from carapace (enlarged).
Fig. 5. *Erimacrus isenbeckii*, epistome.
Fig. 6. *Erimacrus isenbeckii*, female abdomen and sternum.
Fig. 7. *Erimacrus isenbeckii*, bristle from carapace (enlarged).



Erimacrus isenbeckii (reduced).

CATALOGUE OF THE CRABS OF THE FAMILY PERICERIDÆ IN THE U. S. NATIONAL MUSEUM.

BY

MARY J. RATHBUN,

Department of Marine Invertebrates.

(With Plates XXVIII–XL.)

The classification adopted in the following catalogue is that established by Mr. E. J. Miers, in the Journal of the Linnæan Society of London, Vol. XIV, pp. 662 to 667, 1879, and modified by him in the Challenger Report, Zoölogy, Vol. XVII, 1886. His descriptions of *Libinia* and *Pericera* have been amended to receive new species which do not appear to be generically distinct.

In the key are included all the genera supposed to belong to the family. The characters distinguishing those genera which have not been seen by the writer are inclosed in parentheses. In the key to species only those represented in the National Museum are enumerated. At the end of the catalogue a list is given of the species of Pericerida not in the Museum, for the benefit of future students of the group, and also to call attention to the deficiencies of the collection in the hope that it may be enriched in this direction through gifts and exchange.

Of the forty-eight species of Pericerida contained in the National Museum, one is European, two are East Indian, and the remainder American. Of the latter, eleven are found on the Pacific coast, from the Gulf of California to the Galapagos Islands, and thirty-four on the Atlantic coast. Of the Atlantic forms, two only range from Massachusetts southward. The remainder inhabit the southern Atlantic States and the West Indies, in many cases extending to Brazil. Fifteen species are described as new, of which six are from the Gulf of California, and, with two exceptions, represented by a single specimen each.

In addition to the specimens in the National Museum, the writer was enabled to examine also the Pericerida in the Museum of Union College, Schenectady, N. Y., and those contained in a collection made in the Bahama Islands by Mr. Frederick Stearns, of Detroit, Mich., in 1888, and kindly lent by him for study. The latter collection yielded an additional species, which is here described. The writer is indebted

to Mr. James E. Benedict for valuable aid in the preparation of this paper.

In the synonymy, quotations not verified are inclosed in parentheses. Numbers in parentheses after localities are taken from the catalogue books of the museum.

The drawings were made by Mr. A. H. Baldwin, excepting those of *Libinia emarginata* and *dubia*, which are republished from "The Fisheries and Fishery Industries of the United States," through the courtesy of the U. S. Fish Commissioner.

In an appendix are given descriptions of Pericerida collected by the North Pacific Exploring Expedition, preliminary notices of which were published by Dr. William Stimpson, in the Proceedings of the Philadelphia Academy of Natural Sciences, 1857. The specimens were destroyed in the Chicago fire. The figures have been copied and enlarged by Mr. Baldwin from the drawings accompanying the original manuscript.

PERICERIDÆ.

Maioid brachyurans with eyes retractile in complete and well-defined orbits. Basal antennal joint well developed and forming the greater portion of the inferior wall of the orbit.

KEY TO SUBFAMILIES.

A′ Carapace more or less subtriangular. Rostrum well developed. Second joint of antennæ not dilated. Fingers acute at tips.....*Pericerinæ.*

A″ Carapace suboblong; interorbital space very broad. Rostrum very small. Second joint of antennæ enlarged. Fingers excavated at tips.....*Othoniinæ.*

A‴ Carapace broadly triangular, sometimes transverse. Rostrum usually short. Second joint of antennæ not dilated. Fingers excavated at tips..*Mithracinæ.*

KEY TO GENERA.

Pericerinæ.

A′ Rostrum not divided to the base.

B′ Præocular spine distinct.....*Libinia.*

B″ Præocular spine absent.....*Prionorhynchus.*

A″ Rostrum composed of two distinct spines.

B′ Basal joint of antennæ without spine at distal extremity.

C′ (Horns of rostrum lamellate).....*Pyria.**

C″ Horns of rostrum flattened, contiguous, produced at their extremities in a lateral lobe.....*Lissa.*

C‴ Horns of rostrum slender and divergent.....*Picroceroides.*

C⁗ (Horns of rostrum very slender and contiguous).....*Leptopisa.*

C⁗′ (Horns of rostrum small, parallel to each other).....*Sisyphus.**

B″ Basal joint of antennæ with one or more spines at distal extremity.

C′ Carapace narrow and elongated, suboval.

D′ (Nearly vertically deflexed in front of gastric region).....*Cyphocarcinus.*

D″ (Not deflexed in front of gastric region).....*Podohuenia.*

*May belong to the Maiidæ.

C'' Carapace subtriangular.
D' Carapace with a series of lateral spines or teeth.
E' Lateral margins with sharp spines ..... *Pericera.*
E'' (Lateral margins laminate and dentate) ..... *Anaptychus.*
D'' Carapace without a series of lateral spines or teeth.
E' Spines of rostrum very slender and contiguous ..... *Tiarinia.*
E'' Spines of rostrum slender and more or less divergent.
F' (Spine at antero-external angle of antennal joint very short and not visible from above) ..... *Tylocarcinus.*
F'' Spine at antero-external angle of antennal joint very long and visible from above ..... *Microphrys.*
E''' Spines of rostrum parallel or nearly so. Orbits tubular .. *Macrocœloma.*
E'''' (Spines of rostrum short, divergent, obliquely deflexed) .. *Entomonyx.*

Othoniinæ.

A' Carapace with margins regularly dentated ..... *Othonia.*
A'' (Carapace with margins not dentated) ..... *Cyclocœloma.*

Mithracinæ.

A' Ambulatory legs dilated and compressed. Rostrum minute ..... *Thoe.*
A'' Ambulatory legs not dilated and compressed.
B' (Basal antennal joint without spines at distal end) ..... *Parathoe.*
B'' Basal antennal joint with one or more spines at distal end.
C' Lateral margins with tubercles or spines ..... *Mithrax.*
C'' (Lateral margins without tubercles or spines) ..... *Paramaya.**

KEY TO SPECIES EXAMINED.

Libinia.

A' Carapace with margin evenly rounded behind the front.
B' Orbital fissures open; carapace narrowly pyriform ..... *mexicana.*
B'' Orbital fissures closed; carapace broadly ovate.
C' Rostrum deflexed.
D' Median spines six ..... *dubia.*
D'' Median spines nine ..... *emarginata.*
C'' Rostrum pointing obliquely upward ..... *setosa.*
A'' Carapace distended at the hepatic regions.
B' Legs spinous ..... *spinimana.*
B'' Legs unarmed ..... *macdonaldi.*

Prionorhynchus.

Præocular spine absent ..... *edwardsii.*

Lissa.

Gastric region divided by deep grooves from the cardiac and branchial regions . *chiragra.*

Picroceroides.

Horns of rostrum slender and divergent ..... *tubularis.*

* This genus is doubtfully referred to the *Pericerida*.

Pericera.

A′ Carapace with strong median spines.
  B′ Carapace oblong-ovate ..... *atlantica.*
  B″ Carapace triangulate ..... *triangulata.*
A″ Carapace without strong median spines.
  B′ Rostral horns divergent from the base ..... *cornuta.*
  B″ Rostral horns divergent at tips only ..... *contigua.*

Tiarinia

Carapace covered with prominent warty tubercles ..... *cornigera.*

Microphrys.

A′ Rostral horns short, flattened ..... *Microphrys*, sp.
A″ Rostral horns long, thickened ..... *bicornutus.*

Macrocœloma.

A′ Carapace with dorsal spines besides the epibranchial and posterior spines.
  B′ Carapace subtriangular.
    C′ Carapace with four spines at summit.
      D′ Rostrum strongly deflexed ..... *septemspinosa.*
      D″ Rostrum almost horizontal ..... *camptocera.*
    C″ Carapace with spiny ridge between epibranchial spines ..... *subparallela.*
    C‴ Carapace with two spines on the intestinal region ..... *tenuirostra.*
  B″ Carapace subtrapezoidal ..... *eutheca.*
A″ Carapace without dorsal spines except the epibranchial and posterior spines.
  B′ Epibranchial spine two-lobed ..... *diplacantha.*
  B″ Epibranchial spine not lobed ..... *trispinosa.*

Othonia.

A′ Antero-lateral teeth rounded ..... *aculeata.*
A″ Antero-lateral teeth acute.
  B′ Carapace smooth, pubescent ..... *lherminieri.*
  B″ Carapace densely granulous ..... *rotunda.*
  B‴ Carapace tuberculous.
    C′ Carapace broadest at fourth pair of teeth ..... *nicholsi.*
    C″ Carapace broadest at third pair of teeth ..... *carolinensis.*

Thoe.

Antero-lateral margin straight or a little concave ..... *puella.*

Mithrax.

A′ Carapace with dorsal sulci.
  B′ Antero-lateral margins with spines only.
    C′ Carapace longer than broad ..... *cinctimanus.*
    C″ Carapace broader than long ..... *forceps.*
  B″ Antero-lateral margins with lobes, or lobes and spines.
    C′ Carapace much broader than long; lateral margins angular.
      D′ Lateral angle formed by a spine hooked forward ..... *denticulatus.*
      D″ Lateral angle formed by a lobe ..... *coronatus.*
    C″ Carapace slightly broader than long; lateral margin rounded.
      D′ Lateral margin with three large lobes followed by a spine ..... *nodosus.*
      D″ Lateral margin with four small lobes ..... *sculptus.*

A'' Carapace without dorsal sulci.
B' Manus with spines.*
C' Carapace with much flattened, setigerous granules ..... *aculeatus.*
C'' Carapace punctate and spiny ..... *spinosissimus.*
C''' Carapace densely hairy ..... *pilosus.*
B'' Manus without spines.
C' Rostrum tuberculiform.
D' Ambulatory legs with a thin lamellate crest ..... *Mithrax*, sp., Miers.
D'' Ambulatory legs without a thin lamellate crest.
E' Carpus with inner margin armed with two or three blunt spines. *verrucosus.*
E'' Carpus with surface tuberculous.
F' Basal antennal joint with a spine at its antero-lateral angle .... *sinensis.*
F'' Basal antennal joint with a lobe at its antero-lateral angle ... *cristulipes.*
F''' Basal antennal joint with a truncate tooth at its antero-lateral angle ..... *braziliensis.*
E''' Carpus with surface uneven ..... *hispidus.*
C'' Rostrum short and sharp.
D' Carapace strongly tuberculous. Lateral margins heavily armed.. *hemphilli.*
D'' Carapace pubescent. Lateral margins almost unarmed..... *bahamensis.*
C''' Rostrum long and sharp.
D' Carapace strongly tuberculous ..... *acuticornis.*
D'' Carapace with scattered tubercles ..... *spinipes.*

Subfamily PERICERINÆ.

Libinia Leach (amended.)

Leach, Zoöl. Misc., II, p. 129, 1815. Say, Jour. Acad. Nat. Sci. Phila., I, p. 76, 1817. Latreille, Règne Anim., III, p. 21, 1817 (2nd. ed., IV, p. 61); translation, III, p. 46, 1831. (Desmarest, Consid. sur les Crust., p. 161, 1825.) Milne Edwards, Hist. Nat. des Crust., I, p. 298, 1834. De Haan, Fauna Japonica, Crust., p. 86. De Kay, Crust. of N. Y., p. 1, 1844. Dana, Crust. U. S. Ex. Ex., I, p. 80, 1852. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 127, 1875. Miers, Jour. Linn. Soc. London, XIV, p. 662, 1879; Challenger Rept., Zoöl., XVII, p. 72, 1886.

Carapace convex; tuberculous or spinous; triangular-orbiculate and evenly rounded behind the frontal region, or oblong-orbiculate and constricted behind the hepatic regions which are dilated laterally. Præocular spine usually distinct. Rostrum emarginate or bifid at the apex. Orbits small, nearly circular, sometimes with an open fissure in the upper and lower margins. Basal antennal joint moderately enlarged. Merus of exterior maxillipeds truncated at the distal end. Chelipeds well developed; palm elongated; fingers evenly denticulated on inner margins. Ambulatory legs well developed, sometimes elongated; joints subcylindrical, usually unarmed.

Libinia emarginata Leach.

Plate XXXI, fig. 2.

Libinia emarginata Leach, *op. cit.*, p. 130, pl. 108. (Desmarest, *op. cit.*, p. 162.) White, Cat. Brit. Mus. Crust., p. 4, 1847. Smith, Trans. Conn. Acad., V, p. 45, 1879; Verrill's Check List of N. Amer. Invert., p. 1, 1879; Rept. U. S. Commr. of Fisheries for 1885 (1887), p. 627. Kingsley, Proc. Acad. Nat. Sci. Phila., XXXI, p. 386, 1879. Miers, Jour. Linn. Soc. London, XIV, p. 662, 1879; Challenger

* In young specimens and females, the spines are not always evident.

Rept., Zoöl., XVII, p. 72, 1886. Andrews, Trans. Conn. Acad., VI, pp. 99–121, pls. XXV–XXVII, 1883 (anatomy). R. Rathbun, Fishery Industries of United States, sec. I, p. 778, pl. 269, fig. 4, 1884. Kendall, Bull. U. S. Fish Comm., IX, p. 303, 1889 (1891).

Libinia canaliculata. Say, *op. cit.*, p. 77, pl. IV, fig. 1. Milne Edwards, *op. cit.*, p. 300; (Atlas Règne Anim. de Cuvier, Crust., pl. XXIII, fig. 1). Gould, Invert. of Mass., p. 327, 1841. De Kay, *op. cit.*, p. 2 (partim). White, *loc. cit.* Gibbes, Proc. Amer. Assoc. Adv. Sci., 3, p. 169, 1850. Streets, Proc. Acad. Nat. Sci. Phila., XXII, p. 105, 1870. Coues, Proc. Acad. Nat. Sci. Phila., p. 120, 1871. Smith, Rept. U. S. Commr. of Fisheries for 1871 and 1872 (1874), p. 548. A. Milne Edwards, *op. cit.*, p. 128. Kingsley, *op. cit.*, p. 316, 1878.

Libinia affinis. Randall, Jour. Acad. Nat. Sci. Phila., VIII, p. 106, 1839. Gibbes, *op. cit.*, p. 170. Stimpson, Boston Jour. Nat. Hist., VI, p. 455, 1857. Streets, *loc. cit.*

A variety from Charlotte Harbor, Florida, collected by the U. S. Fish Commission schooner *Grampus*, approaches somewhat the *dubia* type. It has the rostrum of *emarginata*, as well as the hepatic, the two intestinal, and the four median gastric spines; but the three branchial spines and those of the lateral margin, as well as some of the median spines, are long and strong as in *dubia*.

One specimen from St. Augustine, Florida, has a rostrum with three spines instead of two, one median, the others regularly diverging on either side.

Occasionally this species occurs in such numbers on the oyster grounds of Long Island Sound, and so interferes with the operations of the steam oyster dredgers that work is abandoned until the crabs (which are known to the oystermen as "spiders") have passed over.

RECORD OF SPECIMENS EXAMINED.

Massachusetts; U. S. Fish Commission:
Wellfleet and Provincetown (2978); Provincetown (3898, 5875); Cape Cod (2025); south of Cape Cod, 27 fathoms (12852); east of Martha's Vineyard, 3 to 7 fathoms (9376); Vineyard Sound, shore to 9 fathoms; Wood's Holl (6704); Menemsha Bight (6710); Buzzards Bay, 5¼ fathoms (4054); Mattapoisett Harbor (5825).

Rhode Island; U. S. Fish Commission:
Narragansett Bay, shore to 15 fathoms.

Connecticut; U. S. Fish Commission:
Noank (5874); New Haven (3843); Savin Rock (4102); oyster beds of H. C. Rowe, mouth of New Haven Harbor (3042); oyster grounds off Milford, Stratford, Bridgeport, and Norwalk (16023).

Long Island:
Fort Pond Bay, U. S. Fish Commission (14582); Fire Island beach, Dr. T. H. Bean (8916).

Virginia; U. S. Fish Commission:
Chesapeake Bay (5870); Hampton Roads, 11 to 12 fathoms (12452).

North Carolina:
Beaufort (Union College Coll.); Middle Sound, near Wilmington, U. S. Fish Commission (3375).

South Carolina; U. S. Fish Commission:
Bull Creek (16074); Charleston Harbor (3911); west end of Skull Creek (16075); Calibogue Sound (16073).

Florida:

St. Augustine, J. G. Hewitt (2018); Southern Florida, Silas Stearns (3147); Florida Reefs, Lieut. J. F. Moser, U. S. Navy, U. S. C. S. S. *Bache* (14998); 4 miles east of Cape Romano, 18 feet, Lieut. J. F. Moser (13059); Marco, H. Hemphill (15122); Charlotte Harbor, U. S. Fish Commission (15203); W. H. Dall (15125); Sarasota Bay, H. Hemphill (15124), (Union College Coll.).

This species is found as far north as Casco Bay.

Libinia dubia Milne Edwards.

Plate XXXI, fig. 1.

Libinia dubia Milne Edwards, Hist. Nat. des Crust., I, p. 300, pl. 14 bis, fig. 2, 1834. Gibbes, *op. cit.*, p. 169. Streets, *op. cit.*, p. 104. Smith, *loc. cit.* A. Milne Edwards, *op. cit.*, p. 129, pl. XVIII, fig. 5. Kingsley, *op. cit.*, p. 316, 1878; XXXI, p. 386, 1879. R. Rathbun, *op. cit.*, p. 778, pl. 269, fig. 5, 1884. Miers, *loc. cit.* Kendall, *loc. cit.* Ives, Proc. Acad. Nat. Sci. Phila., p. 178, 1891. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 53, 1889.

Libinia canaliculata De Kay, *loc. cit.* (partim).

Libinia distincta Guérin, La Sagra's Hist. of Cuba, VII, p. XII, 1856. Capello, Jor. Sci. Lisbon, III, p. 263, pl. 3, fig. 2, 1871. Martens, Archiv. für Natur., XXXVIII, p. 79, pl. IV, figs. 1*a*, 1*b*, 1872.

Libinia rhomboidea Streets, *op. cit.*, p. 106. A. Milne Edwards, *op. cit.*, p. 131. Miers, *loc. cit.*

? Libinia inflata Streets, *loc. cit.*

Among five specimens from near Cedar Keys, Fla., there is one in which the upper orbital fissures are open as in the species of the second section of *Libinia* enumerated by Miers, *op. cit.*, p. 73. The lower margin of one orbit has a very narrow open fissure; in the other orbit, however, the fissure is closed, as in typical specimens.

A specimen from Merida, Yucatan, presents most of the characters of Streets's *rhomboidea*. A. Milne Edwards is probably right in considering this a variety of *dubia*. The specimen has the depressed median spines; the irregular transverse row on the gastric region; the strong spine on the hepatic region, forming with the lateral spines almost a semicircle; and the four strong spines arranged in a rhomboid on the branchial region, a character possessed by many of our specimens of *dubia*. On one side there is an additional smaller spine placed a little in front of the posterior spine of the rhomboid and nearer the median line. The præocular spine is prominent. The rostral spines are slightly divergent as in the typical *dubia*, from which this specimen does not differ essentially except in the strong hepatic spine.

This species is not uncommonly covered with foreign matter, such as worm tubes, oysters, hydroids, and algæ. A female from Barnegat, N. J., about 3 inches long, is encrusted with tubes of *Serpula*, which conceal the carapace with the exception of the posterior margin, the intestinal spine, and the orbits, rendering the identification doubtful. The rostrum is broken. The mass of tubes is about 3 inches high and of greater width. Another female from Great South Bay, Long Island, has an oyster growing vertically on the frontal region, the hinge being

attached to the hepatic region. Still another female, from Barnegat, has an oyster attached to the subhepatic region and extending horizontally forward.

RECORD OF SPECIMENS EXAMINED.

Massachusetts; U. S. Fish Commission:
Woods Holl (4905, 5839); Buzzards Bay, 7 fathoms (4551); Mattapoisett Harbor (15121).
Long Island; Dr. T. H. Bean:
Fire Island (8920); Patchogue (8915).
New Jersey:
Barnegat, William Calverly (5491, 5497); Ocean City, Dr. T. H. Bean (13012); Great Egg Harbor, Dr. William Stimpson (2066); Beesleys Point (2149).
Maryland: Crisfield, U. S. Fish Commission (3261).
Virginia:
Willoughby Point, U. S. Fish Commission (5877); Hungers Wharf, Dr. J. F. Wilkins (4152); Hampton Roads, 12 fathoms (15158); Norfolk (15824); Cape Henry, William Evans (2278).
North Carolina: Beaufort (Union College Coll.).
South Carolina:
Charleston, C. C. Leslie (3141); east end of Sullivans Island, Whiteside and Leslie (3186); oyster grounds, U. S. Fish Commission, 1891 (16076).
Florida:
Cards Sound (15201), Little Gasparilla Pass (15202); U. S. Fish Commission, 1889. Four miles northeast of Key West; Dr. E. Palmer (9252). Key West; D. S. Jordan (5845); H. Hemphill (8962); U. S. Fish Commission (16155). Off Cape Sable (13756), near Cedar Keys (12471); Lieut. J. F. Moser, U. S. Navy, U. S. C. S. S. *Bache*. Marco (15118), Punta Rassa (6436), Charlotte Harbor (15119); Sarasota Bay (6422), Goodland Point (15120), Pass a Grille Reef (6441), Boca Ceiga Bay, inner shore of Pine Key (6445), Cedar Keys (6411); H. Hemphill. Charlotte Harbor; W. H. Dall (12446). Tampa Bay; James Newman (13109). Clearwater (3259). Pensacola; Silas Stearns (4506).
Yucatan: Merida; A Schott (2169).

Libinia setosa Lockington.

Plate XXVIII.

Libinia setosa Lockington, Proc. Cal. Acad. Sci., p. 68, 1876. Streets and Kingsley, Bull. Essex Inst., 9, p. 108, 1877. Miers, Challenger Rept. Zoöl., XVII, p. 73, 1886.

Libinia semizonale Streets, Bull. U. S. Nat. Mus., No. 7, p. 103, 1877.

Lower California (2300). Type of Streets's *semizonale*.

Libinia macdonaldi, sp. nov.

Plate XXIX.

Entire surface, except the fingers and the tips of the ambulatory legs, densely covered with short, soft hairs, which in alcohol are brown, the surface being much lighter when the hairs are removed. Carapace broadly ovate, somewhat contracted behind the hepatic region, which is distended outwardly, a character not common to any of the species

described hitherto. A conspicuous groove defining the inner angle of the branchial region ends anteriorly in a round pit and is interrupted posteriorly at the widest part of the cardiac region, behind which point it is continued almost to the posterior margin and unites with a broad irregular depression occupying the posterior portion of the branchial region; another short groove on the branchial region near the inner angle. There is a pit at the inner angle of the hepatic region, and another further back, between the gastric and branchial regions.

The spines of the carapace are stout and blunt pointed. There are nine on the median line: four on the gastric, one on the genital, two on the cardiac, and two on the intestinal region. There is a spine on the frontal region on either side of the median line from which a ridge extends forward to the rostrum, which is either tuberculous or armed with a small spine. Between these ridges there is a broad, shallow depression. On each gastric region there is a spine which forms a T with those on the median line. There is a line of seven spines beginning at the summit of the hepatic region and terminating with the last antero-lateral spine. There two other strong antero-lateral spines, one at the prominent angle of the hepatic region, and one on the branchial region midway between the other two. There are four additional spines on the branchial region: one between the first and second lateral spines, but a little higher up and smaller; one, small, near the anterior border; two larger, of which one is near the inner angle, and one at some distance posterior, and nearer the margin; a fifth, near the cardiac region, is sometimes wanting, and in one specimen is accompanied by another at a little distance. On the anterior margin of the hepatic region at the base of the lateral spine are one or two small irregular spines directed forward. In some specimens there is a small spine on the postero-lateral margin just back of the last antero-lateral spine.

Rostrum depressed, flattened vertically, composed of two broad spines coalesced for from one-third to more than one-half their length, their outer margins slightly converging.

Orbits with a single closed fissure above and below and prominent præocular and postocular spines. Orbital opening very small in proportion to the size of the carapace. Basal antennal joint broad, with a spine at the base of the second joint, directed downward and forward, and a little smaller spine on the anterior margin near the outer angle.

Merus of external maxilliped strongly notched at its antero-internal angle, slightly rounded at its antero-external angle. Tooth near the distal extremity of the inner margin of the exognath large, acute.

There are several tubercles on the pterygostomian region, and sometimes a small spine on the subbranchial above the base of the first ambulatory leg. Abdomen with a longitudinal carina which is broader in the female than in the male; a spine or spiny tubercle on the first segment, and a tubercle on the second,

Chelipeds slender, not so long as the first pair of ambulatory legs. Merus subcylindrical, with a row above of four spines and a few tubercles; inner, outer, and inferior surfaces, each with a longitudinal row of tubercles. Carpus obscurely tuberculate, with a crest of four tubercles above. Hands compressed, upper and lower margins parallel in the male, tapering in the female. Fingers meeting along their inner edges, evenly dentate.

Ambulatory legs slender, decreasing successively in length. Dactyls slightly arched, shorter than the penultimate joints.

Dimensions of a male in millimeters: Length, including rostrum, 88; width, without spines, 70; length of cheliped, 122; length of first ambulatory leg, 144; length of fourth ambulatory leg, 81.

RECORD OF SPECIMENS EXAMINED.

Gulf of California; U. S. Fish Commission, 1889:

Cat. No.	Station.	Lat. N.	Long. W.	Fathoms.	○	Nature of bottom.
		○ ′	○ ′ ″			
16069	3016	29 40	112 57 00	76	59	gn. M.
16070	3015	29 19	112 50 00	145	54.9	br. M.
16071	3011	28 07	111 39 45	71	57.9	fne. gy. S. brk. Sh.

This species is named after the Hon. Marshall McDonald, U. S. Commissioner of Fish and Fisheries.

Libinia spinimana, sp. nov.

Plate xxx.

Carapace the same general shape as the preceding, studded with numerous sharp spines and covered, excepting on the distal half of the spines, with a dense pubescence, the hairs being lighter and shorter than in *macdonaldi*. The depressions and grooves are placed similarly to those of *macdonaldi*, but are more shallow. There are about twelve prominent spines on the median line; five on the gastric region, two on the genital, two on the cardiac, two on the intestinal, and one on the posterior margin. On the frontal region there are two or three small spines placed longitudinally on either side of a broad shallow groove. On each gastric region there is a spine which forms a transverse line with the second median spine. There is no continuous line of lateral spines, but near the margin there are prominent spines arranged as follows: Three on the hepatic region, the longest at the external angle, the other two on the anterior border and directed forward; two near the anterior portion of the branchial region, and two farther back. There is an irregular row of small spines near the posterior margin. The entire carapace is covered with spines of different sizes, varying with the specimen.

Rostrum but slightly deflexed, flattened vertically, composed of two sharp divergent spines coalesced for about one-third their length.

Orbits as in *macdonaldi;* præocular and postocular spines more prominent than in that species. Basal antennal joint shaped as in *macdon-*

aldi, and bearing besides the two spines of that species a third on the outer margin behind the anterior angle.

Maxillipeds much as in *macdonaldi*. Pterygostomian region armed with a few spines. Abdomen carinated, with a median spine on the first two segments in both sexes. On each side of the second, third, and fourth segments in the female, there is one prominent tubercle, and in some cases one or two smaller ones. In the male there are inconspicuous tubercles on either side of the first three segments.

Chelipeds shorter than the first pair of ambulatory legs; pubescent, except the fingers and distal half of the hand, which are smooth. Ischium with a few short spines. Merus with four longitudinal, equidistant rows of irregular spines, those of the upper margin being the longer. Between these rows are scattered a few small spines. Carpus spiny. Hands and fingers shaped as in *macdonaldi*. Hand with small spines on the proximal half of the upper margin, more prominent in the male than in the female, and sometimes arranged in two rows, which become more divergent toward the distal end, the spines decreasing to small tubercles; inner and lower surfaces finely tuberculate or granulate, with a few stout tubercles in the male at the proximal end of the lower margin.

Ambulatory legs resembling those of *macdonaldi;* pubescent, except the distal two-thirds of the dactyls. Merus of the first pair with a longitudinal row of four or five sharp spines on the upper surface, two on the outer side of the anterior margin, and six or eight smaller scattered spines. Meral joints of the remaining legs with a sharp spine on the outer side of the anterior margin, and one or more minute spines on the anterior portion. Carpal joints of first pair with a few small spines; of remaining pairs sometimes with faint tubercles. Other joints unarmed.

Dimensions of male in millimeters, as follows: Length, including rostrum, 86; width, without spines, 69; length of cheliped, 114; length of first ambulatory leg, 147; length of fourth ambulatory leg, 98.

There is a small male from the Gulf of Mexico, measuring 52 millimeters long and 36 wide, which differs from the three large specimens collected off Cape Lookout, North Carolina, in the following particulars: The dorsal spines are fewer and longer; there is only one spine on the genital region, and one on the anterior margin of the hepatic. The rostral spines are proportionally longer and more divergent. In other respects, however, this specimen agrees with the types.

RECORD OF SPECIMENS EXAMINED.

Cat. No.	Station.	Lat. N.			Long. W.			Fathoms.	Nature of bottom.
		°	′	″	°	′	″		
14029	2602	34	38	30	75	33	30	124	S. R.
16053	2403	28	42	30	85	29	00	88	gy. M.

This species and the preceding differ from all other species of *Libinia* in the prominent hepatic regions, and in the sharp postocular spine directed outward, characters which hardly seem to justify the formation of a new genus. Excepting *L. rostrata* Bell, they are the only species having long rostral horns in connection with closed orbital fissures. *L. spinimana* is peculiar in having spines on the hands.

Libinia mexicana, sp. nov.

Plate XXXI, fig. 3.

Carapace pyriform, covered with a short pubescence and bearing twelve long spines besides the præocular. Median spines four: two on the gastric region (the posterior the longer), one on the cardiac, and one on the intestinal. There is a small spine on each side of the anterior median gastric spine, a tubercle on the genital, and one on the cardiac behind the spine. There are two long spines on each branchial region, one on each side of the genital region, pointing outward and a little forward, the others further from the median line and nearly in line with the cardiac spine, but pointing backward and outward. Lateral spines two: one on the hepatic region, one on the anterior part of each branchial; further back on the margin there is an inconspicuous spiny tubercle.

Rostrum rather long, nearly straight, the distal half bifurcated. Horns tapering; outer margins slightly divergent; interspace V-shaped.

Orbits with an open fissure above and below; præocular spine prominent; postocular well developed, obtuse.

Basal antennal joint rather narrow, with a triangular acute spine at its distal extremity, pointing downward and forward. Second and third joints rather stout. Remaining portion wanting. There is a short spine and two or three tubercles on the pterygostomian region.

Legs short, covered with a close pubescence; joints unarmed. Chelipeds, in a young male, weak, almost as long as the first pair of ambulatory legs. Palms compressed, not dilated. Fingers narrowly gaping, their distal half finely toothed.

Length, without rostrum, 10^{mm}; breadth, 7.5^{mm}; length of rostrum about 3.5^{mm}; length of cheliped about 8.5^{mm}.

Collected in the Gulf of California, off Shoal Point, Mexico, near the mouth of the Colorado River, lat. 31° 33′ N., long. 114° 20′ 30″ W., 10½ fath., fine gray sand, broken shells, station 3029, U. S. Fish Commission, 1889 (16072).

This species is nearest to *L. smithii* Miers, but differs in the narrower carapace, the less divergent rostral horns, the shorter ambulatory legs. The lateral branchial spine is also farther forward in *mexicana*, and the twelve long spines are nearly equal in length, while in *smithii* the cardiac, intestinal, and second lateral spines are longer than the others. The marginal spine of the basal antennal joint is wanting in *mexicana*.

Libinia mexicana belongs to that section of the genus having open orbital fissures, a section which should perhaps form a new genus and be transferred to the Maiidæ.

Prionorhynchus edwardsii Jacquinot and Lucas.

Voy. au Pole Sud, Zool., III, Crust., p. 8, pl. 1, fig. 1, 1853. (Filhol, Rec. Vénus, III, Abth. 2, p. 367, 1886.) Miers, Jour. Linn. Soc. London, XIV, p. 662, 1879.

Upper surface coarsely and densely granulous and closely set with short, coarse hairs. Dimensions in millimeters: Length, 107; width, including teeth, 97.

Auckland Island; Otago University Museum, Dunedin, New Zealand; one male (16297).

Lissa chiragra (Fabricius).

Cancer chiragra (Fabricius, Ent. Syst. 409, 47). Herbst, Natur. der Krabben und Krebse, I, p. 243, pl. 17, fig. 96, 1790.

Inachus chiragra (Fabricius, Sup. Ent. Syst., p. 357, 1798).

Lissa chiragra Leach, Zool. Misc., II, p. 70, pl. 83, 1815. (Desmarest, Consid. sur les Crust., p. 147, 1825.) (Risso, Hist. Nat. de l'Europe Mérid., V, p. 23). (Costa, Fauna Napoli, p. 17.) Milne Edwards, Hist. Nat. des Crust., I, p. 310, 1834. (Latreille, Ill. Ed. Règ. Anim., pl. 29, fig. 1.) (Heller, Crust. S. Europe, p. 47, pl. 1, fig. 26, 1863.) Miers, Jour. Linn. Soc. London, XIV, p. 663, 1879. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, I, p. 53, pl. 3, fig. 5, 1889.

Pisa chiragra (Latreille, Encyc., t. 10, p. 143).

Maia chiragra (Risso, Crust. Nice, p. 47, 1816).

An adult male from Naples (14508) was presented to the National Museum by the Rev. A. M. Norman.

Tiarinia cornigera (Latreille?) Dana.

Pisa cornigera? Latreille (Encycl. Meth., X, p. 141, 1825).

Pericera cornigera? Milne Edwards, Hist. Nat. des Crust., I, p. 335, 1834. Adams and White, Voy. Samarang, p. 18, 1848.

Tiarinia cornigera Dana, Crust. U. S. Expl. Exped., I, p. 110, pl. 3, fig. 5, 1852. Stimpson, Proc. Acad. Nat. Sci. Phila., IX, p. 217, 1857. Miers, Jour. Linn. Soc. London, XIV, p. 664, 1879; Ann. Mag. Nat. Hist. (5), V, p. 228, 1880. Haswell, Cat. Austral. Crust., p. 28, 1882.

Japan; H. Loomis; one female (16271).

This species is distributed throughout the East Indies and the Indian Ocean.

Pericera Latreille (amended).

Latreille, Règne Anim. (2d ed., IV, p. 58, 1829); translation III, p. 43, 1831. Milne Edwards, Hist. Nat. des Crust., I, p. 334, 1834. Dana, Crust U. S. Ex. Ex., I, p. 83, 1852. Saussure, Mém Soc. Phys. de Genève, XIV, p. 426, 1857 (partim). A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 49, 1873. Miers, Jour. Linn. Soc. London, XIV, p. 664, 1879; Challenger Rept., Zool., XVII, p. 76, 1886.

Carapace subpyriform, tuberculated or spinose, with a series of lateral spines. Præocular spine well developed. Spines of rostrum long and more or less divergent. Interorbital space broad. Basal joint of antennæ very much enlarged, usually with two small distant spines at its distal end, not visible from above; sometimes, however,

the spine at the antero-external angle is long and visible from above. Anterior legs long, palm slender and elongated, fingers slightly or not at all gaping.

Pericera cornuta (Herbst).

Cancer cornudo Herbst, Natur. der Krabben u. Krebse, III, pt. 4, p. 6, pl. LIX, fig. 6, 1804.
Maia taurus Lamarck, Hist des Anim. sans Vert, V, p. 242, 1818.
Pericera cornuta Latrèille, Règne Animal (2d ed., IV, p. 58); translation, III, p. 44, 1831. Milne Edwards, Hist. Nat. des Crust., I, p. 335, pl. 14 bis, figs. 4, 5, 1834; (Atlas du Règne Animal de Cuvier, Crustacés, ed. 3, pl. XXX, fig. 1). Gibbes, Proc. Amer. Assoc. Adv. Sci., p. 172, 1850. Guérin, in La Sagra's Hist. of Cuba, p. 11, 1856. Saussure, Mém. Soc. Phys. de Genève, XIV, p. 426, 1857. Stimpson, Ann. Lyc. Nat. Hist. N. Y., VII, p. 183, 1860; Bull. Mus. Comp. Zool., II, p. 113, 1870. (Desbonne and Schramm, Crust. de la Guadéloupe, p. 12, 1867). Streets, Proc. Acad. Nat. Sci. Phila., p. 131, 1872. Martens, Arch. für Natur., XXXVIII, p. 84, 1872. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 51, 1873. Miers, Jour. Linn. Soc. London, XIV, p. 664, pl. XIII, figs. 4, 5, 1879; Challenger Rept., Zool., XVII, p. 76, 1886. Aurivillius, K. Sv. Vet.-Akad Hand., Bd. 23, I, p. 54, pl. 2, fig. 3, 1889.
Chorinus armatus Randall, Jour. Acad. Nat. Sci. Phila., VIII, p. 108, 1839.

Dimensions of largest specimen in millimeters: Length, from tip of rostrum to tip of posterior spine, 146.5; width, including spines, 93; length of rostrum, about 53; length of cheliped, 215.

RECORD OF SPECIMENS EXAMINED.

Savannah, Georgia (Buffalo Soc. Nat. Sci.).
? Gulf of Mexico (5843).
Jamaica (Buffalo Soc. Nat. Sci.); U. S. Fish Comm. (7670); T. H. Morgan, 1891.
St. Thomas; A. H. Riise (2458); U. S. Fish Comm. (16177).

A. Milne Edwards records this species as far south as Bahia.

Pericera cornuta cælata (A. Milne Edwards).

Pericera cælata A. Milne Edwards (Bull. Soc. Philom., June, 1878, p. 5); Miss. Sci. au Mexique, pt. 5, I, p. 200, pl. XV A, fig. 3, 1879; Bull. Mus. Comp. Zool., VIII, p. 1, 1880. Miers, Challenger Rept., Zool., XVII, p. 76, 1886.
Pericera cornuta (?) and *Pericera*, sp., Kendall, Bull. U. S. Fish Commission, IX, p. 303, 1889 (1891).

A comparison of a series of specimens from different localities seems to indicate that *Pericera cælata* A. Milne Edwards is only a variety of *P. cornuta* (Herbst), as Miers has suggested (*loc. cit.*). A. Milne Edwards says of *cornuta* that the rostral horns are shorter, the interorbital space narrower and the carapace smoother than in *cælata*. In this collection there are specimens of typical *cornuta*, and a large series of specimens with prominent tubercles on the carapace, in many cases more spiny than in A. Milne Edwards's *cælata*. In a specimen from the Gulf of Mexico (?), the carapace is smooth, and the rostral horns longer than in any specimen with tuberculous carapace; distally the horns are somewhat convergent. In another smooth specimen, from St. Thomas, the rostral horns are shorter than in many tuberculous specimens,

and do not converge. The comparative length of the rostrum in the two forms is, therefore, not constant. Most of the tuberculous forms have more divergent horns and greater interorbital breadth, but a specimen from Pensacola offers an exception to this rule, having horns no more divergent and a frontal breadth no greater than in the typical *cornuta*. There is then no additional character by which the tuberculous forms can be separated from the smooth. A. Milne Edwards's specimen was 36 millimeters long, including the rostrum. We have specimens of the same size which agree well with his description and figure; but larger specimens differ in having a number of the tubercles spiny; in all cases, however, the tubercles are disposed as in the typical *cornuta*.

In the collection of the museum, *P. cornuta cælata* ranges from 21 to 30 fathoms in the Gulf of Mexico and Caribbean Sea (A. Milne Edwards records it from 175 fathoms); while *cornuta* is found in shallower water.

The young specimens of both varieties it is almost impossible to separate, and under the supposition that the variation in the adults is the result of the different range in depth, I propose to make the deep water form a subspecies of *cornuta* as the best arrangement that can be made with our present knowledge.

Length of largest specimen, from tip of rostrum to tip of posterior spine, 91; width, including spines, about 65; width, without spines, 47.5; length of rostrum, about 30; length of cheliped, 87 millimeters.

RECORD OF SPECIMENS EXAMINED.

Pensacola, Florida, from stomach of fish; Silas Stearns (4505, 9373).
Gulf of Mexico; U. S. Fish Commission, 1885, 1889:

Cat. No.	Station.	Lat. N.	Long. W.	Fathoms.	Nature of bottom.
		° ′ ″	° ′ ″		
16045	2370	29 18 15	85 32 00	25	crs. gy. S. brk. Sh.
15144	2373	29 14 00	85 29 15	25	Co.
15145	2374	29 11 30	85 29 00	26	S. G. brk. Sh.
15147	2405	28 45 00	85 02 00	30	gy. S. brk. Co.
15146	2406	28 46 00	84 49 00	26	crs. S. Co.
9803	2407	28 47 30	84 37 00	24	Co. brk. Sh.
15148	2409	27 04 00	83 21 15	26	crs. gy. S. brk, Sh.
15205	5110	26 19 00	82 50 00	21	Sh. S. bk. Sp.
15150	2412	26 18 30	83 08 45	27	fne. gy. S. bk. Sp. brk. Sh.
15149	2413	26 00 00	82 57 30	24	fne. S. bk. Sp. brk. Sh.
16068	5070	25 23 00	82 54 30	26½	Sh. S.
15276	5063	25 17 00	82 54 30	27	Sh. S.
9847	2414	25 04 30	82 59 15	26	fne. wh. S. brk. Sh.

Off Cape Catoche, Yucatan; U. S. Fish Commision, 1885:

Cat. No.	Station.	Lat. N.	Long. W.	Fathoms.	Nature of bottom.
		° ′ ″	° ′ ″		
9592	2366	22 28 00	87 02 00	27	fne wh. Co.
16051	2365	22 18 00	87 04 00	24	wh. R. Co.
9567	2360	22 08 30	86 49 00	26	wh. Co.
15143	2363	22 07 30	87 06 00	21	wh. R. Co.

Pericera triangulata, sp. nov.

Plate XXXII, fig. 1.

Carapace triangular-ovate, covered with a short, close pubescence. Median spines nine; four on the gastric region, of which the one next the posterior is the longest; one, tuberculous, on the genital region; two on the cardiac, the anterior one the longest of the median spines; and two on the intestinal, the last one projecting almost horizontally over the posterior margin. There are two long spines arranged lengthwise through the center of each branchial region, the anterior one being much nearer the median line. A little farther forward on the branchial region, and in a transverse line with the posterior gastric spine, there is a tubercle. On the branchial there is also a tubercle just above the margin midway between the first and second lateral spines; and a line of three faint tubercles, almost parallel with the antero-lateral margin and between the margin and the dorsal branchial spines. There is a small tubercle on the hepatic region, and a spiny tubercle on the anterior part of each gastric region, almost in line with the first median spine.

Rostral horns straight, widely divergent, with fine hairs on the margins. Præocular spine long, acuminate, strongly upturned; postocular sharp; sinus wide.

Antero-lateral margin slightly convex, armed with three triangular acute spines: one on the hepatic region; one at the lateral angle of the carapace pointing outward and backward; the other half way between, almost parallel with the hepatic spine. From the last lateral spine to the last median spine the margin is marked by an almost straight ridge.

Basal joint of the external antenna with a short tooth at its antero-external angle, and a tubercle at the insertion of the next joint. Remaining joints with a few long marginal ciliæ. Antenna a little longer than the rostrum and inserted underneath it.

Abdomen of immature female with an uneven carina through the center, caused by a tubercle on each segment.

Chelipeds no longer than first pair of ambulatory legs, slender. Merus tuberculous above; hand long, slender, somewhat compressed, slightly tapering. The chelipeds, with the exception of the hands and fingers, and the ambulatory legs, are clothed with a soft, thick pubescence.

Entire length, 18.7 ; width, including second lateral spines, 13.2; width without spines, 10.2; width between tips of postocular spines, 8.3. millimeters.

A single specimen was dredged in the Gulf of California, lat. 28° 28′ N., long. 112° 04′ 30″ W., 29 fathoms, gray sand, temperature 62.9°, station 3014, 1889 (16066).

Pericera atlantica, sp. nov.

Pericera, sp., Smith, Rept. U. S. Commr. of Fisheries for 1885 (1887), p. 627.

Carapace oblong-ovate; spines of the dorsal surface and margin in number and position corresponding to those of *triangulata;* but the spines are shorter and weaker, the two dorsal branchial spines are arranged more longitudinally, and there is no tubercle on the hepatic region and none on the branchial region above the margin. Width of front greater than in *triangulata*. In addition to the close pubescence of the surface, the carapace is covered with long curved hairs. Color in alcohol very light, while *triangulata* is a reddish brown. In other respects this species agrees with *triangulata*, of which it appears to be the Atlantic analogue. It resembles in form specimens of *P. cornuta* of equal size, but the series of dorsal spines, the wider orbital fissures and shorter rostrum separate it from that species.

Entire length, 17; width, including second-lateral spines, 12.3; width without spines, 10.3; width between tips of postocular spines, 9 millimeters.

The above description is made from a young female collected off Key West, Florida, lat. 24° 25′ 45″ N., long. 81° 46′ W., 45 fath., coral, temperature 75°, station 2318, by the U. S. Fish Commission in 1885 (15142). A smaller female was collected in lat. 35° 10′ 40″ N., long. 75° 06′ 10″ W., 68 fath., gray mud, temperature 71.3°, station 2268, 1884 (7220).

Two very small specimens from the Gulf of Mexico, lat. 29° 27′ 30″ N., long. 87° 48′ 30″ W., 30 fath., coarse sand, black specks, shells, station 2390, U. S. Fish Commission, 1885 (16044) have been doubtfully referred to this species. They have the form and orbits of *atlantica*, but are too small for exact determination.

Pericera contigua, sp. nov.

Plate XXXII, fig. 2.

Carapace oblong-ovate, narrower at the orbits than posteriorly; pubescent; armed with three lateral spines: one on the hepatic, one a little above the margin at the postero-lateral angle of the carapace, and the other, the longest, situated halfway between the two.

Protuberances of the dorsal surface arranged as follows: Three spiny tubercles in a triangle on the gastric, the posterior one on the median line most prominent. On each branchial region a spine in a transverse line with the posterior border of the gastric; another spine midway between this and the lateral epibranchial spine; a spiny tubercle close to the posterior-lateral border of the cardiac region; behind the last a rounded tubercle near the posterior margin; and a spiny tubercle on the anterior portion. On the intestinal region, a spiny tubercle, and

behind it another directed upward just over the posterior margin. The cardiac region has a spine at its summit.

Rostrum slightly deflexed, about one-fifth of the entire length of the carapace. Horns somewhat scythe-shaped, thick, regularly tapering, acuminate; convex to each other, separated at base by a slight cavity, then curving inward and in contact for about two-fifths of their length, finally diverging. Præocular spine prominent, long pointed; postocular acute. Basal joint of antenna broad, armed with one long triangular spine, parallel with the præocular spine and visible in a dorsal view.

Pterygostomian regions pubescent, with a few tubercles. Abdomen carinated.

Chelipeds slender, pubescent, a little longer than the first pair of ambulatory legs; merus with an irregular spiny ridge above; hands tapering; fingers slender, in contact for nearly their whole length. Ambulatory legs stout, very pubescent.

In spite of the long spine of the basal antennal joint, I have placed this species in the genus *Pericera*, because it has the orbits of *Pericera* and the lateral row of spines. The prominence of the antennal spine can hardly be said to be a character sufficient to distinguish *Pericera* and *Macrocœloma*, as there is at least one species of *Macrocœloma* in which it is not visible from above, *M. diplacantha* Stimpson. Besides this character, *contigua* can readily be separated from the other known species of *Pericera* by the peculiar rostrum.

Length including rostrum, 28; width without spines, 16.3; width with spines, 21; width between tips of postocular spines, 14 millimeters.

One female from the Gulf of California, lat. 25° 02′ 45″ N., long. 110° 43′ 30″ W., 21 fathoms, sand, shells, coralline, station 3005, U. S. Fish Comm., 1889 (16067), and two males from lat. 31° 21′ N., long. 113° 49′ W., 11 fathoms, sand, broken shells, gravel, temperature 67°, station 3024 (16975).

Picroceroides tubularis Miers.

Challenger Rept., Zool., XVII, p. 77, pl. X, fig. 1, 1886.

In one male the rostral horns and præocular spines are longer than in the specimen figured by Miers. The largest specimen, a female, measures 20.5 millimeters in length from the base of the horns and 13.5 millimeters in width at the branchial regions. Collected off Havana, Cuba, lat. 23° 10′ 25″ N., long. 82° 20′ 24″ W., 33 fathoms, station 2324, coral, temperature 79.1°; by the U. S. Fish Commission steamer *Albatross*, 1885 (9495); also at station 2138, 1884, lat. 17° 44′ 05″ N., long. 75° 39′ W., 23 fathoms, coral, broken shells (6928).

This species was collected on the coast of Brazil by the *Challenger*.

Macrocœloma trispinosa (Latreille).

Pisa trispinosa (Latreille, Encycl. Méth. Hist. Nat., x, p. 142, 1825).

Pericera trispinosa Guérin, Icon. des Crust., pl. 8, fig. 3. Milne Edwards, Hist. Nat. des Crust., I, p. 336, 1834. Saussure, Mém. Soc. Phys. de Genève, XIV, p. 426, 1857. Martens, Archiv. für Natur., XXXVIII, p. 84, pl. IV, figs. 4a, 4b, 1872. A. M. Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 52, pl. XV, fig. 2, 1873, and synonymy; Bull. Mus. Comp. Zool., VIII, p. 1, 1880. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 55, pl. 2, fig. 2, 1889. Ives, Proc. Acad. Nat. Sci. Phila., p. 178, 1891.

Macrocœloma trispinosa Miers, Jour. Linn. Soc. London, XIV, p. 665, 1879; Challenger Rept., Zool., XVII, pp. 79, 80, 1886.

In most of our specimens of this variable species the rostral horns are parallel and deflexed for two-thirds of their length, and then become divergent and upturned. In an individual from Fernando de Noronha, the four lobes at the summit of the carapace are very distinct and defined by deep depressions.

RECORD OF SPECIMENS EXAMINED.

Off North Carolina, U. S. Fish Comm., 1885:
Lat 33° 42′ 45″ N., long. 77° 31′ W., 17 fath., sand, pebbles, sta. 2616 (16178).
Lat. 33° 37′ 15″ N., long. 77° 35′ 30″ W., 17 fath., coarse yellow sand, broken shells, sta. 2618 (16179).

Florida:
Key West, on rocks, low tide; H. Hemphill, 1885 (9279), (Union College Coll.). Eastern Dry Rocks; Dr. E. Palmer, 1884 (9280). Dry Tortugas; Dr. E. Palmer, 1884 (14004). Cedar Keys; Lieut. J. F. Moser, U. S. N., U. S. C. S. S. *Bache*, 1887 (15137). Pensacola; Silas Stearns (4497).

Gulf of Mexico; U. S. Fish Comm., 1885:
Lat. 26° N., long. 82° 57′ 30″ W., 24 fath., fine sand, black specks, broken shells, station 2413 (15136).
Lat. 27° 04′ N., long. 83° 21′ 15″ W., 26 fath., coarse gray sand, broken shells, station 2409 (16055).

Jamaica, T. H. Morgan, 1891.

St. Thomas; U. S. Fish Comm., 1884 (16180).

Curaçao; U. S. Fish Comm., 1884 (16181).

Brazil; R. Rathbun, Hartt Explorations, 1875–1877:
Fernando de Noronha.
Bay of Bahia, 3 to 4 fathoms.

Found also in the Bermudas.

Macrocœloma camptocera (Stimpson).

Plate XXXIII, fig. 2.

Pericera camptocera Stimpson, Bull. Mus. Comp. Zool., II, p. 112, 1870. A. M. Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 57, 1873.

Macrocœloma camptocera Miers, Challenger Rept., Zool., XVII, pp. 79, 80, 1886.

This species is distinct from *trispinosa*, as in a series from eight localities most of the differences pointed out by Stimpson hold good. The rostrum, however, though usually longer than in the specimens of *trispinosa* examined, varies in length, being from more than one-half to less than one-third the length of the post-frontal portion of the carapace.

The difference in the size of the antennæ, noted by Stimpson, is not constant, but varies with the specimen. The four spines of the dorsal surface are situated on the cardiac, gastric, and at the inner angle of the branchial region. In addition to the close pubescence of the carapace, the front, the gastric region and the lateral portions of the branchial region are clothed with long hairs curved at the extremities. The lateral and posterior spines are longer, more slender and upturned than in *trispinosa*.

Total length of large male, 37 millimeters; total width, 29.5 millimeters.

RECORD OF SPECIMENS EXAMINED.

Florida:

Indian Key, among rocks, near low tide; H. Hemphill (15140). Key West; U. S. Fish Commission, 1885 (15141). Off Cape Sable; Lieut. J. F. Moser, U.S. Navy, U. S. C. S. S. *Bache*, 1887 (13757). Marco; H. Hemphill (15139). Lat. 28° 43′ N., long. 82° 56′ W., 17 feet (13055), lat. 28° 50′ N., long. 83° W. (13043), lat. 28° 56′ N., long. 82° 55′ W., 19 feet (13064), Cedar Keys (15138); Lieut. Moser.

Macrocœloma diplacantha (Stimpson).

Pericera diplacantha Stimpson, Ann. Lyc. Nat. Hist. N. Y., VII, p. 183, 1860. (Desbonne and Schramm, Crust. de la Guadeloupe, p. 16, pl. V, figs. 16–18, 1867.) A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 55, pl. XIII, fig. 2, 1873.

Macrocœloma diplacantha Miers, Challenger Rept., Zool., XVII, p. 79, 1886.

RECORD OF SPECIMENS EXAMINED.

Key West, Florida; H. Hemphill, 1885; one female (9365).

St. Thomas; U. S. Fish Comm., 1884; one male (16182).

Old Providence; U. S. Fish Comm., 1884 (9136).

Recorded from Guadaloupe.

Macrocœloma subparallela (Stimpson).

Pericera subparallela Stimpson, Ann. Lyc. Nat. Hist. N. Y., VII, p. 182, 1860. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 54, pl. XIII, fig. 3, 1873.

Pericera vilpini (Desbonne and Schramm, Crust. de la Guadeloupe, p. 12, pl. V, figs. 14, 15, 1867).

Macrocœloma subparallela Miers, Challenger Rept., Zool., XVII, p. 79, 1886.

A male from Florida (?) (16054), 26 millimeters long, has on the posterior portion of the carapace, back of the transverse row of spines and tubercles, the short, tough pubescence arranged in irregular ridges separated by a network of grooves. This character is less strongly marked in the two females from St. Thomas (16183) and Old Providence (16184), U. S. Fish Commission, 1884.

Recorded from Guadaloupe.

Macrocœloma septemspinosa Stimpson.

Pericera septemspinosa Stimpson, Bull. Mus. Comp. Zool., II, p. 113, 1870. A. M. Edwards, Miss. Sci. au Mexique, pt. 5, I, pp. 59, 200, pl. XV A, fig. 2, 1873.

Macrocœloma septemspinosa Miers, Challenger Rept., Zool., XVII, pp. 79, 80, 1886.

RECORD OF SPECIMENS EXAMINED.

The specimens were all collected by the U. S. Fish Commission steamer *Albatross* in 1885.

Off South Carolina.

Cat. No.	Station.	Lat. N.	Long. W.	Fathoms.	Temp.	Nature of bottom.
		° ′ ″	° ′ ″			
15127	2311	32 55 00	77 54 00	79	59.1	crs. S. bk. Sp.

Off Key West, Florida.

Cat. No.	Station.	Lat. N.	Long. W.	Fathoms.	Temp.	Nature of bottom.
		° ′ ″	° ′ ″			
15129	2318	24 25 45	81 46 00	45	75	Co.
15128	2317	24 25 45	81 46 45	45	75	Co.

Gulf of Mexico.

Cat. No.	Station.	Lat. N.	Long. W.	Fathoms.	Nature of bottom.
		° ′ ″	° ′ ″		
15135	2407	28 47 30	84 37 00	24	Co. brk. Sh.
15134	2406	23 46 00	84 49 00	26	crs. S. Co.
15133	2405	28 45 00	85 02 00	30	gy. S. brk. Co.
15132	2373	29 14 00	85 29 15	25	Co.
15131	2372	29 15 30	85 29 30	27	G.
15130	2370	29 18 15	85 32 00	25	crs. gy. S. brk. Sh.

Found as far south as Bahia.

Macrocœloma eutheca (Stimpson).

Pericera eutheca Stimpson, Bull. Mus. Comp. Zool., II, p. 112, 1870. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, pp. 58, 200, pl. XV A, fig. 1, 1873. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 55, pl. 2, fig. 1, 1889.

Macrocœloma eutheca Miers, Challenger Rept., Zool., XVII, pp. 80, 82, 1886.

To this species I have referred an adult male from off Havana, lat. 23° 10′ 51″ N., long. 82° 19′ 03″ W., 163 fath., white and brown coral, station 2323, U. S. Fish Commission, 1885 (9492); also a young male from near Aspinwall, lat. 9° 32′ N., long. 79° 54′ 30″ W., 34 fath., broken shells, station 2146, 1884 (7780); and a young female from lat. 23° 10′ 36″ N., long. 82° 20′ 20″ W., 122 fath., coral, station 2168 (7756).

The adult male differs from Stimpson's description in its slightly narrower carapace, longer rostrum with divergent horns, and in the presence of tubercles instead of spines on the gastric region. A. Milne Edwards figures, without remark, a specimen which he calls *eutheca*, although it is much narrower than the one in question, the posterior half of the carapace is much rounded, and the rostral horns are separated by a triangular interspace.

The specimen under examination has the carapace very much narrower posteriorly than in *M. concava* Miers (*Op. cit.*, p. 81, pl. X, fig. 2),

from which it differs also in the protuberances of the carapace. In its proportion it approaches nearer the figure given by Aurivillius (*loc. cit.*). A detailed description of the individual is given below, as a series may in the future connect these two species. The two small specimens in the collection offer no essential differences.

Carapace with a scattered pubescence, subtrapezoidal, concave at the hepatic region; outline of branchial region rounded. The protuberances of the carapace are as follows: three tubercles forming a triangle on the gastric region, the posterior one large and on the median line, the other two inconspicuous; a spiny tubercle on the cardiac region; another longer on the intestinal; on the branchial region, a prominent slender spine just above the margin and behind the broadest part of the carapace; above this spine another very small; on the lateral margin an irregular row of small spines and spiny tubercles, one on the hepatic and about five on the branchial, the one next to the last being the longest, but only two-thirds as long as the epibranchial spine; a branch of this marginal row is continued on the pterygostomian region, which is covered with small tubercles.

Rostrum thin, almost straight; horns separated by a triangulate space; their distal half slender, acuminate; proximal half broad, subtriangular, with convex outer margin.

Orbital sheaths long, prominent. Distance between the tips of the postocular spines a little greater than the width of the carapace at the branchial regions exclusive of spines. On the upper orbital margin there is a tooth above the postocular; and a small spine on the lower margin. Basal joint of external antennæ armed with two sharp spines.

Chelipeds moderate. Merus tuberculous, with a row of four small spines above. Hands long, compressed, finely pubescent. Fingers arched, partially gaping; distal third brown. First pair of ambulatory legs barely reaching the manus.

Entire length, 25; length of rostrum, 6; width at the branchial regions, without spines, 15.6; length of cheliped, 28; length of first ambulatory leg, 20 millimeters.

M. cuthcca has been collected at the Tortugas, Florida Straits, 12 to 115 fathoms, Santa Cruz, besides other localities.

Macrocœloma tenuirostra, sp. nov.

Plate XXXIII, fig. 1.

Carapace much longer than broad, subrectangular, slightly convex; finely pubescent. Epibranchial spine short, slender; posterior margin with a slender upturned spine. Dorsal surface with a blunt median spine above the posterior margin; a tubercle occupying the cardiac region; another far back on the gastric region; remainder of the surface with small depressed tubercles, which on the antero-lateral margin form an indistinct row.

Rostrum very slender, more than half as long as the remainder of the carapace. Horns subcylindrical, tapering to a fine point; outer margin spinulose for its posterior half; a narrow interspace at base; horns contiguous for the middle third; slightly divergent at tips.

Orbits slightly projecting. Præocular and postocular teeth distinct, acute. Basal antennal joint with a short spine at the antero-external angle, visible from above. There is a tooth at the insertion of the second joint, pointing downward; and an obtuse tooth on the outer margin. Remaining joints very slender.

Chelipeds long, slender, pubescent except on the fingers. Merus and carpus tuberculate. Hand long, compressed, not dilated, granulate. Fingers in male gaping at base; tips brown; a short broad tooth on the dactyl. Ambulatory legs very slender, pubescent. First pair much longer than the others. Dactyls spinulose beneath.

Length of carapace, including rostrum and posterior spine, 22; length of rostrum, 7.5; branchial width, including spines, 10; without spines, 8.5; width between tips of præocular teeth, 6 millimeters.

One individual, a male, was taken in the tangles, between Jamaica and Hayti, lat. 17° 44′ 05″ N., long. 75° 39′ W., 23 fathoms, coral, broken shells, station 2138, 1884, U. S. Fish Commission (6929).

This species can not be confounded with any other described species of the genus, on account of its narrow, elongated carapace and slender rostrum.

Microphrys bicornutus (Latreille).

Pisa bicornuta (Latreille, Encyc. Méth., x, p. 141, 1825).

Pericera bicorna Milne Edwards, Hist. Nat. des Crust., I, p. 337, 1834.

Pisa bicorna Gibbes, Proc. Amer. Assoc. Adv. Sci., 3, p. 170, 1850.

Pericera bicornuta Guérin, in La Sagra's Hist. of Cuba, p. XII, 1856. Martens, Arch. für Natur., XXXVIII, p. 85, pl. IV, fig. 5, 1872.

Pericera bicornis Saussure, Rev. et Mag. de Zool., (2), IX, p. 501, 1857; Mém. Soc. Phys. Genève, XIV, p. 428, pl. 1, fig. 3, 1857.

Milnia bicornuta Stimpson, Ann. Lyc. Nat. Hist. N. Y., VII, p. 180, 1860; Bull. Mus. Comp. Zool., II, p. 111, 1870. Smith, Trans. Conn. Acad., II, pp. 1, 33, 1869; Amer. Jour. Sci., XLVIII, p. 389, 1869.

Pisa galibica (Desbonne and Schramm, Crust. de la Guadéloupe, p. 18, 1867).

Pisa purpurea (Desbonne and Schramm, *loc. cit.*).

Omalacantha hirsuta Streets, Proc. Acad. Nat. Sci. Phila., (3), I, p. 238, 1871. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 65, 1873.

Microphrys bicornutus A. Milne Edwards, Nouv. Archiv. Mus. Hist. Nat., VIII, p. 247, 1872; Miss. Sci. au Mexique, pt. 5, I, p. 61, pl. XIV, figs. 2–4, 1873. Miers, Challenger Rept., Zool., XVII, p. 83, 1886. Heilprin, Proc. Acad. Nat. Sci. Phila., p. 318, 1888. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 55, pl. 2, fig. 4, 1889. Pocock, Jour. Linn. Soc. London, XX, p. 507, 1890. Ives, Proc. Acad. Nat. Sci. Phila., p. 178, 1891. Kendall, Bull. U. S. Fish Comm., IX, p. 303, 1889 (1891).

Microphrys bicornuta Kingsley, Proc. Acad. Nat. Sci. Phila., XXXI, p. 386, 1879.

RECORD OF SPECIMENS EXAMINED.

Florida:

Cape Florida; Dr. E. Palmer, 1884 (9360). Key Largo; H. Hemphill (15116). Lower Matacumba Key, among grass, below low tide; H. Hemphill (15114). Indian Key; H. Hemphill (15117). Florida Bay (Union College Coll.).

Key Vaccas (14070), Nights Key (15112), No Name Key (15111), Big Pine Key (15113); H. Hemphill. Harbor Key (Union College Coll.). Key West Harbor; Dr. E. Palmer, 1884 (15115). Key West; D. S. Jordan, 1883 (5749); H. Hemphill (9354); U. S. Fish Commission (11390), (Union College Coll.). Plantation Key (Union College Coll.). Dry Tortugas reefs, from corals and sponges; Dr. E. Palmer, 1884 (9362). Garden Key, Tortugas (15825). Marco; H. Hemphill (16056). Bird Key; U. S. Fish Commission, 1889 (15207).

Bermudas:

Tuckers Island; Dr. George Hawes (13796). Dr. F. V. Hamlin, Wesleyan University (4024).

Bahamas: Andros Island (Stearns Coll.); New Providence, U. S. Fish Commission, 1886 (11369).

Jamaica; T. H. Morgan, 1891.

West Indies, U. S. Fish Commission:

Jamaica (16057); St. Thomas (16186); Curaçao (7580); Old Providence (16185); near Aspinwall, lat. 9° 32′ N., long. 79° 54′ 30″ W., 34 fathoms, broken shells, sta. 2146 (16187).

Barbados; U. S. Eclipse Expedition to West Africa, 1890 (14883).

Sabanilla, U. S. of Colombia; U. S. Fish Commission, 1884 (16058).

Brazil; R. Rathbun, Hartt Explorations, 1875–1877; Pernambuco; Rio Formoso, Pernambuco; Plataforma, Bahia, in tide pools; Fernando de Noronha.

Microphrys, sp.

Carapace broadly triangulate. Regions well defined, tuberculous. There is one sharp spine at the lateral angle of the carapace; a little nearer the median line are two spiny tubercles. Anterior portion of branchial region much swollen in an oblong tuberculous lobe. There are small tubercles on the margin of the hepatic region and on the subbranchial region.

Rostrum depressed, short, reaching to the middle of the third joint of antennæ. Horns narrowly triangular, acute, separated by a narrow V-shaped notch. Præocular angle distinct.

Basal antennal joint with two marginal teeth separated by a narrow sinus; the anterior tooth long, flat, procurved, subacute.

Chelipeds in young female weak, not much longer than first pair of ambulatory legs. Merus with four tubercles on upper margin; carpus tuberculous on outer surface; margins of hand subparallel; fingers evenly dentate, gaping at base.

Ambulatory legs with meral joints spinous above and tuberculous on outer face; carpal joints with one spine above; propodal joints with a broad, rounded, lamelliform process for the articulation of the dactyl, as in *platysoma*.

Length, including rostrum, 12 millimeters; width, without spines, 9 millimeters.

Gulf of California, lat. 28° 16′ N., long. 111° 54′ W., 22 fathoms, fine gray sand, temperature 63°, station 3012, U. S. Fish Commission, 1889 (16774).

This species appears to be nearest to *bicornutus*. The species described from the Pacific coast are so numerous and the literature so inad-

equate that the writer, with only one immature specimen at hand, hesitates to give a name to a species perhaps already overburdened.

Subfamily OTHONIINÆ.

Othonia aculeata (Gibbes).

Plate XXXIV, figs. 1 and 2.

Hyas aculeata Gibbes, Proc. Amer. Assoc. Adv. Sci., 3, p. 171, 1850.
Othonia aculeata Stimpson, Ann. Lyc. Nat. Hist., N. Y., VII, p. 49, 1859; Bull. Mus. Comp. Zool., II, p. 116, 1870 (partim). A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 115, pl. XXIV, fig. 4, 1875. Kingsley, Proc. Acad. Nat. Sci. Phila., XXXI, p. 388, 1879 (partim). Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, I, p. 56, 1889.

See remarks under *Othonia lherminieri* Schramm.

RECORD OF SPECIMENS EXAMINED.

Florida:
Key Largo (14049), Lower Matacumba Key (15809), Indian Key (14054), Key Vaccas (14072), Nights Key (15089); H. Hemphill. Key West; H. Hemphill (9283); D. S. Jordan (5751), U. S. Fish Commission (7518). Dry Tortugas; Dr. E. Palmer (13896). Sarasota Bay, one young specimen (Union College Coll.).
Bahamas; U. S. Fish Commission, 1886:
Nassau (11401); New Providence (16309).

Found also at St. Thomas.

Othonia lherminieri Schramm.

Plate XXXIV, figs. 3 and 4.

Othonia lherminieri (Schramm, Crust. de la Guadeloupe, p. 20, 1867). A. Milne Edwards, Miss Sci. au Mexique, pt. 5, I, p. 116, pl. XXIV, fig. 5, 1875.
Othonia aculeata Stimpson, Bull. Mus. Comp. Zool., II, p. 116, 1870 (partim). Kingsley, Proc. Acad. Nat. Sci. Phila., XXXI, p. 388, 1879 (partim).
Othonia anisodon Martens, Archiv. für Natur., p. 83, pl. IV, fig. 3, 1872.

An examination of numerous lots of this species proves it to be very distinct from *O. aculeata* (Gibbes), with which it has been confounded by some authors.

The front is much narrower than in *aculeata*, rostrum more advanced and less deflexed. In *aculeata* a groove runs from the tip of the inner upper angle of the orbit along the margin of the front to the base of the rostrum. This groove is very slight in *lherminieri*. Orbital angles less produced and less conspicuous in *lherminieri*. In both species the basal article of the external antenna has the anterior margin more or less dentate. Second article, in *lherminieri*, with an external lobe which is shorter than in *aculeata* and directed forward rather than outward. Antero-lateral teeth sharp, while in *aculeata* they are obtuse.

Appendages of the male abdomen with the distal third of a light brown color, and gradually tapering; and arranged in the form of a lyre, widely spreading at the tips (Pl. XXXIV, fig. 4). In *aculeata*, the appendages are brown for about the distal half, the brown parts in con-

tact for one-half their length, diverging at the extremities in slight curves convex to each other, each appendage terminating in a right-angled hook, the point of which is directed toward the median line of the carapace (Pl. XXXIV, fig. 2).

The chelipeds are variable, in full grown males usually slender, shorter than the first pair of ambulatory legs and not much stronger than in the female; but in five out of fifteen large males the chelipeds are from one and a half times to nearly twice as long as the carapace, and are of the same character as in *aculeata*. The palms are, however, longer and narrower, and the merus more cylindrical and less angled than in *aculeata*, in which species the merus has three depressed tubercles on the upper margin. The two species agree in the widely gaping fingers of the male, with a tooth near the base of the dactyl, and in the short, weak chelipeds of the female, with fingers evenly dentate and in contact.

The carpal joints of the ambulatory legs are longer and more slender than in *aculeata*, and have a shallow groove on the outer surface which in *aculeata* is broad and deep, leaving a conspicuous ridge on either side.

The carapace of *lherminieri* is smoother and more pubescent; that of *aculeata* more tuberculous; a character most noticeable in very young specimens.

RECORD OF SPECIMENS EXAMINED.

Florida:

Key Largo (15090), Lower Matacumba Key (14085), No Name Key (14077); H. Hemphill. Harbor Key (Union College Coll.). Key West; H. Hemphill (9286); D. S. Jordan (15093), U. S. Fish Commission (15092). South Florida; S. Stearns (3463). Marco (15091), Punta Rassa (13837), Charlotte Harbor (15096); H. Hemphill. Charlotte Harbor, young (Union College Coll.). Sarasota Bay; H. Hemphill (6424, 6431); (Union College Coll.). Boca Ceiga Bay; H. Hemphill (15094). Off northwest end St. Martins Reef; Lieut. J. F. Moser, U. S. N. (15097). Cedar Keys; H. Hemphill (15095).

Jamaica; T. H. Morgan, 1891.

West Indies; U. S. Fish Commission, 1884:

Jamaica (16188); St. Thomas (16189); Curaçao (16190); Old Providence (9133).

Sabanilla, United States of Colombia; U. S. Fish Commission, 1884 (15820).

On the west coast of Florida where *lherminieri* is abundant, *aculeata* rarely occurs, but one small specimen in the Union College collection representing that region.

O. lherminieri has been recorded from Guadaloupe and Cuba.

Othonia carolinensis, sp. nov.

Plate XXXV, figs. 1 and 2.

The following description is based on two imperfect male specimens collected off Charleston, S. C., by Mr. R. E. Earll, U. S. Fish Commission, 1880:

Carapace nearly as broad as long, tapering posteriorly, broadest at the third antero-lateral tooth; regions well defined. Width of front intermediate between that of *aculeata* and *lherminieri*. Carapace with

scattered tubercles, six or eight on the branchial region, four or five on the mesogastric, two or three on the gastric, and a row near the posterior margin. The rostrum and the inner and outer orbital angles are about equally advanced. Orbital angles acute.

Antero-lateral teeth five, the first three prominent, acute, the fourth smaller, the fifth almost obsolete. Sinus between the second and third not so deep as between the first and second, making a partial coalescence of the second and third teeth, which, however, is very slight as compared with the coalescence of the same teeth in *aculeata* and *herminieri*, where the second tooth is much more feeble than the first and third.

Basal article of the antenna with a shallow emargination on its anterior border outside the insertion of the second article, which is narrower than in *herminieri*, the outer lobe produced forward but little beyond the inner lobe. Remaining articles wanting in our specimens.

Appendages of the male abdomen in contact at about three-fifths of the distance from the distal end, then separating slightly in faint curves concave to each other, and again converging before they finally spread out at the tips. Distal three-fifths yellow, very slender, tapering gradually to a fine point (pl. XXXV, fig. 2).

Chelipeds small, longer than the first pair of ambulatory legs. Merus somewhat angled, unarmed. Palms about one and a half times as long as broad, tapering slightly toward the distal end. Fingers with distal half minutely dentate and in contact; proximal ends gaping, a slight tooth at the base of the dactyl. Ambulatory legs short, sparsely hairy, a longitudinal depression on the carpal joints as in *aculeata*.

Length, 14.2 millimeters; width, 14 millimeters; width of front, 8.7 millimeters.

RECORD OF SPECIMENS EXAMINED.

Near Charleston Harbor, 1 to 12 fathoms (3158).
Blackfish Bank, off Charleston, 12 fathoms, from stomach of fish (5755).

An egg-bearing female from Jamaica, T. H. Morgan, 1891, has been doubtfully referred to this species. The carapace is wider posteriorly and narrower in the center, sparsely pubescent. The basal antennal joint is dentate on its anterior margin.

Othonia nicholsi, sp. nov

Plate XXXV, fig. 3.

Carapace oblong, outline of anterior portion much as in *aculeata*, broader posteriorly. Carapace with strongly marked tubercles of which the larger are arranged as follows: Two on the median line of the mesogastric, the anterior one the smaller; two transversely on the anterior part of the cardiac region; three or four on each branchial region, where they have a tendency to become spiny. Of smaller tubercles, there is one on each gastric lobe, two transversely at the

posterior end of the mesogastric, one on the anterior edge of the cardiac. There is a long line of stout granules a little above the posterior margin; a shorter line of granules behind this; a curved line of four granules just back of the middle of the cardiac region, arranged concave to the posterior margin; and two lines of granules on the posterior half of the branchial region, one following the general direction of the posterior margin, the other shorter, along the inner boundary of the branchial region and meeting the first line at an acute angle. There are other granules scattered on the carapace, but no conspicuous protuberances on the hepatic region.

Lobes of the rostrum acute, emarginate on their inner margins near the tips. Orbital angles sharp, the inner one produced in a line with the tip of the rostrum, the outer angle less produced.

Antero-lateral teeth five, irregular, the second small and somewhat coalesced with the third at its base. Carapace broadest at the fourth tooth. Fifth tooth small.

Basal joint of antenna with its anterior margin cut into three irregular teeth. Second joint with the lobe at its outer angle projecting laterally, but not so long as in *aculeata*.

Meral joint of outer maxillipeds longer than broad; antero-external angle produced; no perceptible notch at internal angle.

Chelipeds in the young female slender, no longer than the first pair of ambulatory legs. Merus somewhat angled; carpus compressed; upper and lower margins of hand subparallel; fingers finely dentate, with a narrow hiatus at their base.

Ambulatory legs with a fine scattered pubescence. Carpal joints distended as in *aculeata* with an uneven ridge above and a longitudinal depression on the outer face.

Length from tip of rostrum, 9 millimeters; greatest width, 8.5 millimeters.

Collected in the Gulf of California, lat. 29° 30′ N., long. 112° 40′ W., 45 fath., by Lieut. Commander H. E. Nichols, U. S. Navy, 1880–1882 (15822); specimen imperfect, dried.

This species can hardly be identical with *O. picteti* Saussure (Rev. et Mag. de Zoöl. (2), v, p. 357, pl. 13, fig. 2, 1853) as the carapace is broader posteriorly, the tubercles are differently disposed, the front is broader, and the orbital angles more produced than in Saussure's figure.

Othonia rotunda, sp. nov.

Plate xxxvi, fig. 1.

Carapace as broad as long, widest at the fourth antero-lateral teeth, much swollen in both directions, transversely rising abruptly from the bases of the antero-lateral teeth, longitudinally rising in almost an equal curve from behind the front and from the posterior margin. Regions faintly indicated. Carapace covered with granules which are more thickly set on the posterior half. Long fine hairs proceed from

the top of the granules. Along the outer margins of the gastric lobes, bunches of granules beset with coarse hairs form a broad line which is continued to the rostrum. Rostral teeth sharp, produced beyond the orbital angles. Præorbital angle obtuse, less produced than the post-orbital, which is subacute.

Antero-lateral teeth usually five in number (in one specimen four), acute, separated to their bases, the first the largest, the others as a rule decreasing regularly in size to the posterior, the tips of the five teeth making a single curve. In the largest specimen, however, the third tooth on one side is much smaller than the fourth; the third tooth on the other side is broken, but, judging from the base, it was intermediate in size between the second and fourth. Anterior margins of teeth thickened. Antero-lateral margin marked by inconspicuous granules irregularly placed, giving the teeth the appearance of being themselves minutely dentate.

Basal article of the antenna with a sharp longitudinal groove through the middle. Tooth at distal extremity slightly more produced than the superior inner angle of the orbit, and visible in a dorsal view. Second article broad, with the outer lobe directed forward, and slightly thickened on the outer and anterior margins. Third article as broad as long.

Surface of the abdomen and the sternum minutely pubescent. Appendages of male abdomen diverging slightly at the distal ends, hooked at the tips.

Chelipeds in both sexes, slender, longer than the ambulatory legs, covered with fine punctures, upper margin with thinly scattered hairs. Merus angled, a few small tubercles on the upper margin. Manus very slightly tapering toward the distal end. Fingers in the male gaping for the proximal third, with a tooth on the dactyl; in the female, evenly dentate and in contact for nearly their whole length, a slight gape at the proximal end. Ambulatory legs very hairy above, first pair reaching to about the middle of the manus.

Length and width of large female, 17.5 millimeters; width of front, 9.8 millimeters. Length and width of largest male, 14 millimeters; width of front, 8.5 millimeters.

Ten specimens were collected at Key West, Fla., by Henry Hemphill, 1885 (15807), and one female at the same locality, by the U. S. Fish Commission in 1884 (16298).

Subfamily MITHRACINÆ.

Mithrax (Nemausa) spinipes (Bell).

Pisa spinipes Bell, Trans. Zoöl. Soc., London, II, p. 50, pl. IX, fig. 6, 1836.
Nemausa spinipes A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 82, 1875. Miers, Jour. Linn. Soc., London, XIV, p. 666, 1879.
Mithrax (Nemausa) spinipes Miers, Challenger Rept. Zoöl., XVII, p. 85, 1886.

A single male from the Gulf of California, has been referred to this species. It is a smaller specimen than the one figured by Bell (*loc. cit.*)

and differs in some respects. The original description says that there are seven or eight lateral spines (A. Milne Edwards says six or seven), and in the figure there are six besides the postorbital. In our specimen there are five besides the postorbital, the fourth being the longest and defining the lateral angle of the carapace, the fifth shorter than the others and elevated a little on the branchial region.

The granules of the anterior two-thirds of the carapace are very inconspicuous. There are two large granules on the median line of the cardiac region, five or six granules on the posterior half of the branchial region, and a conspicuous row of four spiny granules on the intestinal region, making a curve concave to the posterior margin. The two teeth on the upper margin of the orbit are minutely serrate. The orbital sinuses are deeper than in other species of *Mithrax*.

Spine at antero-external angle of basal antennal joint about half as long as the rostrum; remaining tooth spiniform.

Chelipeds in our specimens shorter than the first pair of ambulatory legs. Merus spiny, bearing on the anterior part of its upper margin one or two spines longer and more slender than the rest. Carpus tuberculous, some of the tubercles spiny. Hands slender, smooth. Fingers spoon-shaped, finely dentate, when closed showing but a faint hiatus.

Ambulatory legs pubescent, third and fourth joints with long spines above, third joint with small spines below.

Length from base of rostral horns, 11 millimeters; width, without spines, 8.2 millimeters.

Lat. 24° 55′ 15″ N., long. 110° 39′ W., 33 fathoms, fine gray sand, broken shells, temperature 64.5°, station 3001, U. S. Fish Commission, 1889 (16064).

Bell records this species from the Galapagos Islands, 16 fathoms, and St. Elena, 6 fathoms.

Mithrax (Nemausa) acuticornis (Stimpson).

Plate XXXVII, fig. 1.

Mithrax acuticornis Stimpson, Bull. Mus. Comp. Zoöl., II, p. 116, 1870. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 98, 1875. Miers, Challenger Rept., Zoöl., XVII, pp, 86, 88, 1886.

Mithrax (?) sp., Kendall, Bull. U. S. Fish Commission, IX, p. 303, 1889 (1891).

Stimpson says, "The margin of the orbit is armed with six spiniform teeth, not including those of the antennal joint." In some of the specimens examined the tooth on the inferior margin of the orbit next to the basal antennal joint is obliterated, leaving only five orbital teeth; three on the superior margin, one at the external angle, and one on the inferior margin.

The following are the dimensions of three specimens, the length measured from the base of the rostrum, and the width, not including the spines. No. 1. Length 13; width 10 millimeters; ratio 1 : .77. No. 2.

Length 11; width 9 millimeters; ratio 1 :.82. No. 3. Length 10.5; width 9 millimeters; ratio 1 :.86.

The color in alcohol is a cinnamon brown; fingers of a pinkish tinge.

I think this species is not the young form of *M. cornutus* Saussure. In large specimens of *cornutus*, according to A. Milne Edwards, the length is only a trifle greater than the width; while in our series of *acuticornis*, the larger the specimen the narrower the carapace. In *acuticornis* the præocular spine is proportionally shorter and the antennal spine longer than in Milne Edwards's figure of *cornutus*. In the twenty-two specimens examined there is no trace of spines on the manus.

The young *Mithrax* enumerated by Mr. W. C. Kendall (*loc. cit.*) in his list of Brachyura collected by the schooner *Grampus* on the fishing grounds off the west coast of Florida, undoubtedly belongs to this species.

RECORD OF SPECIMENS EXAMINED.

Gulf of Mexico; U. S. Fish Commission, 1885 and 1889:

Cat. No.	Station.	Lat. N.	Long. W.	Fathoms.	Temperature.	Nature of bottom.
		° ′ ″	° ′ ″			
15811	2406	28 46 00	84 49 00	26		crs. S. Co.
15819	2409	27 04 00	83 21 15	26		crs. gy. S. brk. Sh.
15817	2411	26 33 30	83 15 30	27		fne. wh. S. bk. Sp.
15206	5108	26 19 00	83 11 00	27	68	S. algæ.
15812	2413	26 00 00	82 57 30	24		fne S. bk. Sp. brk. Sh.
15813	2414	25 04 30	82 59 15	26		fne. wh. S. brk. Sh.

Caribbean Sea; U. S. Fish Commission, 1885:

Cat. No.	Station.	Lat. N.	Long. W.	Fathoms.	Nature of bottom.
		° ′ ″	° ′ ″		
9502	2330	23 10 48	82 19 15	121	fne. gy. Co.
15818	2365	22 18 00	87 04 00	24	wh. R. Co.
16307	2362	22 08 30	86 53 30	25	Co. S.
15814	2363	22 07 30	87 06 00	21	wh. R. Co.
7760	2136	17 43 30	75 38 25	52	Co. brk. Sh.

Mithrax spinosissimus (Lamarck).

Maia spinosissima Lamarck, Hist. Nat. des Anim. sans Vert., v, p. 241, 1818; 2d ed., p. 435, 1838.

Mithrax spinosissimus Milne Edwards, Mag. Zoöl., II, pls. 2 and 3, 1832; Hist. Nat. des Crust., I, p. 321, 1834. White, Cat. Brit. Mus. Crust., p. 6, 1847. Gibbes, Proc. Amer. Assoc. Adv. Sci., III, p. 172, 1850. Guérin, La Sagra's Hist. of Cuba, p. x, 1856. Stimpson, Amer. Jour. Sci., XXIX, p. 132, 1860; Ann. Lyc. Nat. Hist. N. Y., VII, p. 188, 1860. (Desbonne and Schramm, Crust. de la Guadeloupe, p. 4, pl. VIII, fig. 24, 1867.) Martens, Arch. für Natur., XXXVIII, p. 81, 1872. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 100, 1875. Kingsley, Proc. Acad. Nat. Sci. Phila., XXXI, p. 390, 1879 (partim).* Miers, Challenger Rept. Zoöl., XVII, p. 86, 1886. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 57, 1889.

*The specimens here recorded by Mr. Kingsley as *spinosissimus* prove to be *aculeatus*.

RECORD OF SPECIMENS EXAMINED.

Florida:

G. Wurdemann (2093, 15816). Carysfort Reef; Dr. E. Palmer (9257). Harbor Key (Union College Coll.). Key West; D. S. Jordan (5758); U. S. Fish Commission (7339); H. Hemphill (9258). Garden Key, Tortugas (15081).

Off Havana, Cuba, lat. 23° 10′ 48″ N., long. 82° 19′ 15″ W., 121 fathoms, fine gray coral, station 2330, U. S. Fish Commission, 1885 (9502).

Havana, Cuba; D. S. Jordan (7854).

Guadaloupe; L. Guesde (4095).

Mithrax pilosus, sp. nov.

Plate XXXIX.

Carapace ovate-orbicular; width, without spines, less than the length. Postero-lateral margin rather long for the genus. Entire upper surface of the crab except the fingers, the proximal half of the manus, and the horny tips of the dactyls of the ambulatory legs closely covered with velvety hairs, which are present also on all the spines. Carapace furnished with spinose tubercles as follows: Three, small, arranged longitudinally each side of the median line just behind the rostrum; four transversely on the gastric region in two distant pairs; one further back on the median line of the gastric; three forming a triangle on the cardiac; nine or ten scattered on each branchial region; four in an arcuate row above the posterior margin.

Rostrum composed of two spines strongly incurved at the tips; interspace U-shaped. Præocular spine distinct, upturned.

Lateral spines five, stout, triangular, tips hooked forward. The fifth of the series is on the postero-lateral margin. Farther back is a very small spine. There is also a small spine between the first and second lateral and the second and third lateral. There are three small tubercles on the posterior margin.

Basal antennal joint broad. Spine at the antero-external angle about as long as the rostrum, but not so much advanced, directed outward; tip turned inward. Farther back on the outer margin there is a sharp triangular tooth, and another at the insertion of the second joint. Flagellum rather long. There is a triangular tooth on the lower orbital border next the postocular tooth. Lower surface of the crab covered with a short pubescence.

Chelipeds a little shorter than the next pair of legs, not enlarged. Merus and carpus spiny above, the merus widening at the proximal end, the spines forming a crest on the distal half. Hand compressed, tapering slightly towards the fingers, spinose on the upper surface near the base, a character present in both sexes. Fingers slightly gaping at base. Ambulatory legs very stout. Meral and carpal joints with two rows of spines above; carpal joints with one or two additional spines. Propodal joints short, broadly cylindrical; those of the first three pairs of legs with one or more spinose tubercles. Dactyls broad at the articulation, tapering abruptly to the curved horny tip.

When the hairs are removed, the surface is speckled with small purple spots.

Length of carapace, with rostrum, 28; width, with spines, 30; without spines, 24; length of cheliped, about 26 millimeters.

Three males and one young female were collected at Abaco, Bahamas, by the U. S. Fish Commission steamer *Albatross*, 1886 (16299).

This species is very distinct from any hitherto described. Like *spinosissimus*, *aculeatus*, and *cornutus*, it has spines on the manus, but it is readily distinguished from those species by the stout lateral spines, the dense pubescence, and the short legs.

Mithrax hemphilli, sp. nov.

Plate XXXVII, fig. 2.

Carapace oblong-triangular, covered with strong tubercles and granules. Regions distinct. The largest tubercles are arranged as follows: One on either side of the median line on the frontal region; a transverse row of four on the gastric; two on the median line of the mesogastric, the posterior one being the larger; one on the genital region; a line of three across the cardiac forming a transverse curve concave to the front; behind these, one on the median line; about seven strong tubercles on the branchial region, those most posterior being spinous; four spinous tubercles on the intestinal region forming a transverse curve concave to the posterior margin. The two tubercles at the extremities of this curve are continuous with a line of granules which border the posterior margin. The two central protuberances of the marginal line are small tubercles. Besides the strong tubercles of the carapace, there are numerous smaller tubercles and granules, scattered or clustered about the larger tubercles. There is a row of granules just within and parallel to the posterior margin of the mesogastric region.

Rostrum rather long for the genus, but not so long as in *acuticornis*, divided by a U-shaped sinus, each horn bearing two or three minute denticles on its outer margin near the tip. Præocular tooth long, acuminate. The two sinuses of the upper orbital margin small, V-shaped.

Antero-lateral teeth four, stout, conical, pointed, and so embossed with granules about their sides that their margins have more or less the appearance of being denticulate. There is a spiny tubercle in the sinus between the second and third teeth, also a spine near the margin of the branchial region just back of the last antero-lateral tooth, which forms the angle of the carapace.

The basal joint of the antenna is armed with four spines and teeth. There is a long slender spine at the anterior outer angle, and farther back a broad triangular tooth which forms part of the orbital margin. At the base of the movable joint is a prominent spiniform tooth, visible in a dorsal view. Just below the sinus between the two marginal teeth is another small tooth, which, with the one at the base of the

movable joint, forms part of a row of six teeth ending at the subhepatic region. There are several irregular rows of tubercles beneath the lateral teeth of the carapace.

Chelipeds slightly longer than the first pair of ambulatory legs. Merus with spinous margins, a ridge of strong spines above, and tubercles on the inner and outer faces. Carpus covered with tubercles, some of which are spiny. Hands smooth, upper and lower margins nearly parallel. Fingers finely dentate, showing when closed only a slight hiatus at the base.

Ambulatory legs pubescent, with the meral and carpal joints flattened above, both margins of the upper faces with strong spines. Lower margins with a few small spines. Propodal joints with a few weak spines above.

Length, from base of horns, 15.5 millimeters; width, exclusive of spines, 13.5 millimeters; proportion, 1: .871.

Indian Key, Fla.; H. Hemphill, 1885 (15823); one immature female.

A somewhat worn specimen of a male not differing essentially from the above description was collected at Rio Formoso, Pernambuco, Brazil, by R. Rathbun, 1875–1877.

Mithrax aculeatus (Herbst).

Cancer aculeatus Herbst, Natur. der Krabben und Krebse, I, p. 248, pl. XIX, fig. 104, 1782.

Mithrax aculeatus Milne Edwards, Mag. de Zool., II, 1832; Hist. Nat. des Crust., I, p. 321, 1834; (Atlas du Règne Animal de Cuvier, pl. 27, fig. 1). White, Cat. Brit. Mus. Crust., p. 6, 1847. Stimpson, Amer. Jour. Sci., XXIX, p. 132, 1860; Ann. Lyc. Nat. Hist. N. Y., VII, p. 188, 1860. (Desbonne and Schramm, Crust. de la Guadeloupe, p. 5, 1867.) Martens, Arch. für Natur., XXXVIII, p. 81, 1872. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 102, 1875. Miers, Challenger Rept., Zool., XVII, p. 86, 1886. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 56, 1889.

There are no specimens of large size in the collection. In individuals one and a half inches long the rostrum is no longer than in specimens of *verrucosus* of the same size.

RECORD OF SPECIMENS EXAMINED.

Florida:

Indian Key (14081), Nights Key (14073), Big Pine Key (14030); H. Hemphill. Key West; H. Hemphill (13820), (Union College Coll.). Key West Harbor; Dr. E. Palmer (15810).

Bahamas:

Andros Island, young, fragmentary (Stearns Coll.); Abaco, U. S. Fish Commission, 1886 (16301).

Jamaica; T. H. Morgan, 1891.

St. Thomas, U. S. Fish Commission, 1884 (16191).

San Domingo; W. M. Gabb, 1878 (4171).

Fernando de Noronha, Brazil; R. Rathbun, 1875–'77.

This species has also been recorded from Vera Cruz.

Mithrax verrucosus Milne Edwards.

Milne Edwards, Mag. de Zool., II, pl. IV, 1832; Hist. Nat. des Crust., I, p. 321, 1834. White, Cat. Brit. Mus. Crust., p. 6, 1847. Gibbes, Proc. Amer. Assoc. Adv. Sci., III, p. 172, 1850. Guérin, in La Sagra's Hist. of Cuba, p. 10, 1856. Stimpson, Amer. Jour. Sci., XXIX, p. 132, 1860; Ann. Lyc. Nat. Hist. N. Y., VII, p. 187, 1860. (Desbonne and Schramm, Crust. de la Guadeloupe, p. 6, 1867.) Martens, Arch. für Natur., XXXVIII, p. 82, 1872. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 102, 1875. Miers, Challenger Rept., Zool., XVII, p. 86, 1886. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 57, 1889. Pocock, Jour. Linn. Soc. London, XX, p. 507, 1890.

RECORD OF SPECIMENS EXAMINED.

Big Pine Key, Florida, H. Hemphill (15075).
Swan Island, Caribbean Sea; C. H. Townsend, 1887 (15074).

Previously recorded from the islands of Fernando de Noronha and "St. Barthelemy."

Mithrax hispidus (Herbst).

Cancer hispidus Herbst, Natur. der Krabben und Krebse, I, p. 247, pl. XVIII, fig. 100, 1782.

Maia spini-cincta Lamarck, Hist. Nat. des Anim. sans Vert., V, p. 241, 1818; 2d ed., p. 434, 1838. Say, Jour. Acad. Nat. Sci. Phila., I, p. 458, 1818.

Mithrax spinicinctus (Desmarest, Consid. sur les Crust., p. 150, pl. XXIII, figs. 1, 2). Guérin, Iconographie du Règne Animal, Crust., pl. VII, fig. 5, 1828. White, Cat. Brit. Mus. Crust., p. 7, 1847.

Mithrax hispidus Milne Edwards, Mag. de Zool., II, 1832; Hist. Nat. des Crust., 1, p. 322, 1834. De Kay, Crust. of New York, p. 4, 1844. White, *op. cit.*, p. 6. Gibbes, Proc. Amer. Assoc. Adv. Sci., III, p. 172, 1850. Saussure, Mém. Soc. Phys. de Genève, XIV, p. 423, 1857. Stimpson, Amer. Jour. Sci., XXIX, p. 132, 1860; Ann. Lyc. Nat. Hist. N. Y., VII, p. 188, 1860; Bull. Mus. Comp. Zool., II, p. 116, 1870. (Desbonne and Schramm, Crust. de la Guadeloupe, p. 7, 1867.) Smith, Trans. Conn. Acad., II, pp. 2, 32, 1869; Amer. Jour. Sci., XLVIII, p. 389, 1869. Martens, Arch. für Natur., XXXVIII, p. 82, 1872. (Schramm, Rev. et Mag. de Zool., (3), II, p. 342, 1874.) A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 39, pl. XXI, fig. 1, 1875. Kingsley, Proc. Acad. Nat. Sci. Phila., XXXI, p. 390, 1879. Miers, Jour. Linn. Soc. London, XIV, p. 667, pl. XIII, figs. 7, 8, 1879; Challenger Rept., Zool., XVII, p. 86, 1886.

Mithrax pleuracanthus Stimpson, *loc. cit.* A. Milne Edwards, *op. cit.*, p. 95, pl. XX, fig. 3. Kingsley, *loc. cit.* Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 58, 1889.

Mithrax hispidus var. *pleuracanthus* Miers, *op. cit.*, p. 88.

A comparison of a number of small specimens from many different localities leads me to believe that the *pleuracanthus* of Stimpson is not even a variety, but merely the young form of *hispidus*. As a rule, the smaller the specimen the more tuberculous the carapace, the sharper the teeth or spines of the orbit and basal joint of the antenna, and the less evident are the punctures of the carapace. The specimens of medium size show characters intermediate between these and the large or typical *hispidus*, so that there seems to be no line where a separation can be made into two distinct varieties. In many young specimens all the antero-lateral teeth except the last have a tendency to

become blunt, and each tooth consists of a central spine or tooth with a cluster of tubercles surrounding it. One female, however, measuring 20 millimeters wide between the tips of the spines, has teeth even more slender than in large specimens. The carpus in small specimens is more or less tuberculous.

Length of largest specimen from tip of rostrum, 86.5 millimeters; width, including spines, 114 millimeters.

RECORD OF SPECIMENS EXAMINED.

Off Cape Fear, North Carolina, 14 to 17 fathoms, stations 2616 to 2619; U. S. Fish Commission, 1885.

Blackfish Banks, off Charleston, South Carolina; R. E. Earll, U. S. Fish Commission, 1880 (5760).

Florida:

Lower Matacumba Key; H. Hemphill (15077). Indian Key; H. Hemphill (15076). Florida Bay (Union College Coll.). Key Vaccas; H. Hemphill (15806). Between Salt Pond Key and Stock Island; Dr. E. Palmer (9282). Four miles northeast of Key West; Dr. E. Palmer (9253). Key West (Union College Coll.). Eastern Dry Rocks; Dr. E. Palmer (13853). Marco; H. Hemphill (6983). Oyster Bay; H. Hemphill (15079). Sarasota Islands; Walker and Stearns (16050). Sarasota Bay (Union College Coll.). Off northwest end St. Martins Reef; Lieut. J. F. Moser, U. S. Navy, U. S. S. C. S. *Bache*, 1887 (13044). Lat. 28° 56′ N., long. 82° 55′ W., 19 feet; Lieut. J. F. Moser (13063). Cedar Keys; Lieut. J. F. Moser (12474). Pensacola; S. Stearns, 1882 (4501), from stomach of fish (9372).

Coast of Southern United States; U. S. Fish Commission, 1880 (5780).

Gulf of Mexico; U. S. Fish Commission, 1885:

Lat. 26° N., long. 82° 57′ 30″ W., 24 fathoms, station 2413 (15080).

Lat. 28° 47′ 30″ N., long. 84° 37′ W., 24 fathoms, station 2407 (15805).

Bermudas; G. Brown Goode, 1876–1877.

Bahamas:

Andros Island (Stearns Coll.); Abaco, U. S. Fish Commission, 1886 (16302).

Jamaica; T. H. Morgan, 1891.

West Indies; U. S. Fish Commission, 1884:

St. Thomas (7651); Curaçao (16192); Old Providence (16193).

Brazil; R. Rathbun, Hartt Explorations, 1875–1877. (All the branchial spines long and sharp):

Bom Fim, Bahia, on stone reef.

Plataforma, Bahia.

Mithrax sinensis, sp. nov.

Plate XXXVIII, fig. 2.

Carapace ovate, a little longer than broad, covered with tubercles. A deep sulcus divides the hepatic and branchial from the gastric and cardiac regions.

Front shaped much as in *hispidus;* rostrum consisting of two tuberculiform and granulate teeth separated by a rounded sinus. Præocular angle obtuse; margin denticulate. Orbit with six teeth besides those of the antennal joint: three on the superior margin, one at the external angle, and two on the inferior margin.

Antero-lateral spines four, tuberculiform, irregular in shape; the first most distinct and surrounded by the tubercles of the hepatic region; the second and third each having on its anterior margin a spiny tubercle almost as large as the tooth itself. Last tooth single.

Basal joint of the antenna with a spiniform tooth at the antero-external angle visible from above, and another farther back almost as large; also a smaller tooth at the insertion of the movable joint.

Chelipeds moderate. Merus tuberculous, armed with six spines on the outer margin, a row of smaller spines on either side of the outer margin, and three spines on the inner margin. Carpus strongly tuberculous. Hand slightly compressed, smooth, unarmed, showing scattered punctures under the lens. Fingers stout, prehensile edges crenulate, with a slight hiatus at the base. Ambulatory legs with fine scattered hairs; meral joints having two longitudinal rows of spines above; carpal and propodal joints with short spines above; dactyls spiny below.

Color in alcohol reddish; hands of a deeper hue.

Entire length, 9.2 millimeters; width, including tubercles, 8.9 millimeters.

Gulf of California, lat. 25° 02′ 15″ N., long. 110° 43′ 30″ W., 17 fathoms, sand, shells, station 3002, U. S. Fish Commission, 1889 (16065).

In general appearance this species most nearly resembles *hispidus;* the prominences of the dorsal surface, the shape of the front and præorbital tooth, are very much as in specimens of *hispidus* of the same size. In *sinensis*, however, the last antero-lateral tooth is not long and conspicuous as in *hispidus*, and the lateral angle of the carapace is not well defined.

Mithrax bahamensis, sp. nov.

Plate XXXVIII, fig. 1.

Carapace longer than broad, oblong-ovate, covered with a close, tough pubescence. There is a tuft of hair near the inner angle of the branchial region; another behind each gastric lobe; and a line of hair extending from the rostrum back upon the gastric. Gastric region elevated. Tubercles of the surface not prominent. There are two on the frontal region, one on each gastric lobe, five or six on each branchial region besides the marginal tubercles, and four in a curve concave to the posterior margin.

Front deflexed, composed of two sharp incurved horns; interspace broadly U-shaped.

Antero-lateral margin with four protuberances: one on the hepatic region, a spiny tubercle; three on the branchial region of which the first two are tubercles, the last a small spine.

Præocular spine acute, conspicuous; postocular subacute; two intervening teeth, small. There is a small suborbital tooth besides those of the basal joint.

Merus joint of exterior maxillipeds deeply cut at the antero-internal angle.

Basal joint of antenna with a small tooth at the base of the movable joint. Spine at external angle, long, more advanced than the præocular spine, incurved. There is a smaller spine farther back on the margin. Remaining joints long with long hairs on the margins.

There are two subhepatic tubercles, and an irregular longitudinal line of four granules on the vertical face of the subbranchial region.

Chelipeds a little longer than the first pair of ambulatory legs, pubescent like the carapace. Upper margin of merus tuberculous. Carpus with one or two faint tubercles on the posterior end of the upper surface. Manus in the male with upper and lower margins almost parallel, slightly contracted near the fingers. There is a small tooth at the base of the dactyl. Fingers gaping at base. Ambulatory legs with the joints flattened above; margins beset with long hairs.

Color in alcohol, reddish brown; chelipeds lighter. Fingers pinkish red for their proximal half; tips white.

Length of largest specimen 18.8; greatest width, 16.5; width at postocular teeth, 11.2 millimeters.

Found with *Mithrax cinctimanus* in sponges at Andros Island, Bahamas, by Mr. Frederick Stearns, 1888.

This species in its shape and antero-lateral teeth most nearly resembles *cinctimanus*, but it is more oblong, more convex, and is also readily distinguished by the absence of sulci on the branchial regions, and by the flattened joints of the ambulatory legs.

Mithrax cinctimanus (Stimpson).

Mithraculus cinctimanus Stimpson, Amer. Jour Sci., XXIX, p. 132, 1860; Ann. Lyc. Nat. Hist. N. Y., VII, p. 186, 1860. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 112, pl. XXIII, fig. 3, 1875. Kingsley, Proc. Acad. Nat. Sci. Phila., XXXI, p. 389, 1879. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 59, 1889.
Mithrax affinis (Desbonne and Schramm, Crust. de la Guadeloupe, p. 10, 1867).
Mithrax cinctimanus Miers, Challenger Rept., Zool., XVII, p. 87, 1886.

RECORD OF SPECIMENS EXAMINED:

Florida:

Cape Florida (15084), Carysport Reef (13897), Rodriguez Creek (14429), Salt Pond Key (14439), Eastern Dry Rocks (14437); Dr. E. Palmer. Harbor Key and Plantation Key (Union College Coll.). Key West; H. Hemphill (13830), (Union College Coll.), U. S. Fish Comm. (16194).

Andros Island, Bahamas (Stearns Coll.).

Jamaica; T. H. Morgan, 1891.

St. Thomas and Curaçao; U. S. Fish Comm., 1884 (16195, 16196).

Found also in the Gulf Mexico.

Mithrax braziliensis, sp. nov.

Plate XXXVI, fig. 2.

Carapace a little broader than long, ovate, slightly convex, without sulci. Regions faintly defined. There is a short line of indistinct flattened tubercles extending back from each rostral lobe, and two or three

tubercles and a few granules near the lateral border of each branchial region. The surface above the posterior margin is covered with scattered granules.

Rostral lobes very short, truncate, minutely crenulate; interspace broadly V-shaped. Upper orbital border with two small teeth.

Antero-lateral spines four; the hepatic spine is subacute, with tubercles on its anterior border; branchial spines sharp, procurved, with a small spine anterior to the first and second. On the postero-lateral border just back of the lateral angle is a minute depressed spine.

Basal antennal joint with three teeth visible from above; the tooth at the insertion of the next joint subacute; the one at the external angle, truncate; posterior tooth acute. Two additional teeth on the suborbital border; that next the postocular tooth acute; the other rounded, serrulate. Subhepatic and subbranchial regions tuberculate.

Chelipeds longer and larger than the next pair of legs. Merus with a row of five sharp spines above, two tubercles on the lower inner border, a triangle of three spines on the inner face, two spines on the upper anterior margin, and two on the outer surface near the anterior border. Carpus with two or three tubercles near the merus and two on the inner margin. Hand smooth, unarmed, with scattered punctures. Fingers slightly gaping at base with a tooth on the dactyl in both sexes. Ambulatory legs with meral and carpal joints spinose above; propodal joints and dactyls unarmed.

Carapace and ambulatory legs finely pubescent. In the largest specimen from Pernambuco the carapace is denuded, probably accidentally, and the surface under the lens presents a cellular structure with scattered punctures. Alcoholic specimens show traces of crimson.

Length of carapace, 15 millimeters; width without spines, 15.5 millimeters.

Mar Grande, Bay of Bahia, one specimen; Rio Formoso, Pernambuco, five specimens; collected by R. Rathbun, 1875–1877.

This species, in the characters of the front, lateral spines, and legs, is very much like *forceps*, from which it is at once separated by the comparative smoothness of the carapace. The sharp tooth on the basal antennal joint, forming part of the suborbital border, is conspicuous in this species. The præorbital angle is not advanced as in *forceps*, and the legs are less hairy.

Mithrax forceps (A. Milne Edwards).

Mithraculus forceps A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 109, pl. XXIII, fig. 1, 1875.

Mithraculus hirsutipes Kingsley, Proc. Boston Soc. Nat. Hist., XX, p. 147, 1879; Proc. Acad. Nat. Sci. Phila., XXXI, p. 389, pl. XIV, fig. 1, 1879. Heilprin, *op. cit.*, p. 318, 1888.

Mithrax forceps Miers, Challenger Rept., Zool., XVII, pp. 87, 88, 1886.

Mithrax hirsutipes Miers, *op. cit.*, p. 87.

A large series of specimens from nineteen different localities shows this species to be extremely variable. The small specimens show marked

variations from those described by A. Milne Edwards, and some of them are identical with Kingsley's *Mithraculus hirsutipes*. The specimens intermediate in size present every gradation in character between the large and small and prove the two extremes to be variations of one species.

Carapace subtriangular, comparatively smooth, the large specimens with scattered punctures, the small ones deeply sculptured. In large specimens three grooves run diagonally backward from near the first, second, and fourth sinuses of the antero-lateral margin to the cardiac region. There are six or seven depressed tubercles along the margin and on the posterior part of the branchial region, two or three along the outer margin of the hepatic region, and two pairs on the frontal region directly behind the lobes of the rostrum. In small specimens the grooves are deeper and the tubercles more prominent; the outline of the mesogastric region is well defined; and there are depressed tubercles on the anterior part of the gastric region.

Lobes of rostrum short, broad; median notch broadly V-shaped. Orbital angles acute, internal angle prominent.

Antero-lateral teeth four, acute, slender, separated by broad rounded sinuses, the first the shortest and in large specimens subacute, the remainder sharp and directed forward, the second one usually the longest and largest. In some specimens there is a small fifth tooth on the postero-lateral margin just back of the fourth tooth.

In large specimens, chelipeds proportionately larger, strong and smooth. Merus with five spines or spiniform tubercles on the upper margin, two on the inner face just below the margin. On the inner margin are two prominent teeth, the anterior one often more or less flattened, broad and obtuse, the posterior one sometimes with a lobe on its posterior margin. Carpus rounded, smooth, sometimes unarmed, often with a short spine or tubercle on the inner margin, anterior to the inner angle, which is often produced in a less conspicuous prominence, giving the carpus the appearance of being double-toothed.

Hands from the articulation to the tips of the fingers much longer than the carapace, broad, compressed; upper and lower margins nearly parallel. Dactyl long, arched, with a tooth one-third the distance from the proximal end. Fingers widely gaping when closed. The fingers are exceedingly variable. Sometimes there are from one to three small irregular teeth or tubercles on the pollex half way to the end. Sometimes there are a few minute teeth on the dactyl instead of one large one. In some of the females and smaller males the dactyl is little arched and the gape is slight.

Ambulatory legs spiny and hairy above, propodal joints slightly hairy below, dactyls equally hairy above and below.

It is the rule that the smaller the specimen the more prominent the protuberances, the sharper the teeth and spines. Small specimens have the meral spines acuminate and occasionally two tubercles on the carpus near its posterior margin.

This species approaches most nearly to *sculptus*, but the antero-lateral teeth are sharp instead of tuberculous, the carapace is invariably wider, the ambulatory legs are less hairy, the color is cinnamon, while in *sculptus* it is sage green or bluish green. While the configuration of the carapace is very variable, in no case is the posterior half deeply sculptured and the anterior half smooth, as is often the case in *sculptus*. Of the three ridges running from the antero-lateral margin to the cardiac region, the two anterior ones are continuous and not broken up by transverse grooves as in *sculptus*.

Length of largest specimen, measuring between the rostral lobes, 30.5; width, without spines, 35 millimeters. Length of three large males, 25; width, 29 millimeters.

RECORD OF SPECIMENS EXAMINED.

Off Cape Fear, North Carolina, 15 to 17 fathoms, stations 2616, 2618, 2623; U. S. Fish Commission, 1885.

South Carolina; R. E. Earll, U. S. Fish Commission, 1880:

Near Charleston Harbor, 1 to 12 fathoms (3159). Fifteen miles southeast of Charleston (5062, 5823).

Florida:

Cape Florida (13928), Rodriguez Creek (16048), Eastern Dry Rocks (16049); Dr. E. Palmer. Indian Key (16046), Key West (16047); H. Hemphill. Sarasota Bay (Union College Coll.).

Coast of Southern States; U. S. Fish Commission, 1880 (16061).

Bermudas; G. Brown Goode, 1876–'77.

Nassau, Bahamas; U. S. Fish Commission, 1886; one, young (11412).

West Indies; U. S. Fish Commission, 1884:

St. Thomas (16197); Curaçao (16198); Old Providence (9130).

Brazil; R. Rathbun, Hartt Explorations, 1875–'77:

Rio Formoso, Pernambuco; Plataforma, Bahia.

This species is found also in Guiana.

Mithrax sculptus (Lamarck).

Maia sculpta Lamarck, Hist. Anim. sans Vert., v, p. 242, 1818; 2d ed., p. 436, 1838.

Mithrax sculptus Milne Edwards, Mag. de Zool., II, pl. v, 1832; Hist. Nat. des Crust., I, p. 322, 1834. Gibbes, Proc. Amer. Assoc. Adv. Sci., III, p. 172, 1850. Guérin, La Sagra's Hist. of Cuba, p. 11, 1856. Martens, Archiv für Natur., XXXVIII, p. 83, 1872. Miers, Challenger Rept., Zool., XVII, p. 87, 1886.

Mithraculus coronatus White, Cat. Brit. Mus. Crust., p. 7, 1847 (partim).

Mithrax minutus Saussure, Mém. Soc. Phys. de Genève, XIV, p. 425, pl. I, fig. 1, 1857. (Desbonne and Schramm, Crust. de la Guadeloupe, p. 10, 1867.)

Mithraculus sculptus Stimpson, Amer. Jour. Sci., XXIX, p. 132, 1860; Ann. Lyc. Nat. Hist. N. Y., VII, p. 186, 1860; Bull. Mus. Comp. Zool., II, p. 117, 1870. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 105, pl. XX, fig. 2, 1875. Miers, Jour. Linn. Soc. London, XIV, p. 667, 1879. Kingsley, Proc. Acad. Nat. Sci. Phila., XXXI, p. 389, 1879. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 58, 1889. Kendall, Bull. U. S. Fish Commission, IX, p. 303, 1889 (1891).

RECORD OF SPECIMENS EXAMINED.

Florida:

Cape Florida (13892), Cæsar's Creek (12441), Rodriguez Creek (13900), Dry Tortugas (13891); Dr. E. Palmer, 1884. Key Largo (14050), Indian Key

(14058), Key Vaccas (15087), Nights Key (15085), Big Pine Key (15086); H. Hemphill. Key West; H. Hemphill (13816), (Union College Coll.), U. S. Fish Commission, 1884 (16303). Bird Key; U. S. Fish Commission, 1889 (15208).

Bahamas: Andros Island (Stearns Coll.); New Providence (16310), Abaco (16304); U. S. Fish Commission, 1886.

Jamaica; U. S. Fish Commission, 1884 (15821); T. H. Morgan, 1891.

Swan Island; C. H. Townsend, 1887 (13984).

Barbados; U. S. Eclipse Expedition, 1890 (14885).

St. Thomas (7650), Old Providence (16199); U. S. Fish Commission, 1884.

Previously recorded from Fernando Noronha, 7 to 20 fathoms.

Mithrax coronatus (Herbst).

Cancer coronatus Herbst, Natur. der Krabben und Krebse, I, p. 184, pl. XI, fig. 63, 1782.

Cancer coryphe Herbst, *op. cit.*, III, p. 8, 1801.

Mithraculus coronatus White, Cat. Brit. Mus. Crust., p. 7, 1847 (partim). Stimpson, Amer. Jour. Sci., XXIX, p. 132, 1860; Ann. Lyc. Nat. Hist. N. Y., VII, p. 186, 1860; Bull. Mus. Comp. Zool., II, p. 118, 1870. Smith, Trans. Conn. Acad., II, pp. 1, 32, 1869; Amer. Jour. Sci., XLVIII, p. 389, 1869. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 106, pl. XX, fig. 1, 1875. Kingsley, Proc. Acad. Nat. Sci. Phila., XXXI, p. 388, 1879. Aurivillius, K. Sv. Vet.-Akad. Hand., Bd. 23, 1, p. 58, pl. III, fig. 8, 1889.

Mithrax sculptus (Desbonne and Schramm, Crust. de la Guadeloupe, p. 9, 1867).

Mithrax coronatus Miers, Challenger Rept., Zool., XVII, pp. 87, 89, 1886. Pocock, Jour. Linn. Soc. London, XX, p. 510, 1890

RECORD OF SPECIMENS EXAMINED.

Florida:

Indian Key, H. Hemphill (15083); Key West, H. Hemphill (15082), (Union College Coll.).

Abaco, Bahamas; U. S. Fish Commission, 1886 (11374).

Jamaica; T. H. Morgan, 1891.

St. Thomas; U. S. Fish Commission, 1884 (16200); Hartt Explorations, 1870.

Brazil; R. Rathbun, Hartt Explorations, 1875–'77: Pernambuco; Rio Formoso, Pernambuco; Mar Grande, Bahia; Fernando de Noronha.

Found also in Central America and in the West Indies to 30 fathoms.

Mithrax denticulatus Bell.

Mithrax denticulatus Bell, Trans. Zool. Soc. London, II, p. 54, pl. XI, fig. 2, 1836. Miers, Challenger Rept., Zool., XVII, p. 87, 1886.

Mithraculus denticulatus White, Cat. Brit. Mus. Crust., p. 7, 1847. Stimpson, Amer. Jour. Sci., XXIX, p. 132, 1860; Ann. Lyc. Nat. Hist. N. Y., VII, p. 187, 1860. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 109, pl. XXIII, fig. 4, 1875.

Entire length of carapace in largest male, 13; width, including spines, 19 millimeters; in another male, length, 12; width, 16.8 millimeters.

Panama; Capt. John Dow (3209).

This species ranges from California to Ecuador.

Mithrax nodosus Bell.

Mithrax nodosus Bell, Trans. Zool. Soc. London, II, p. 53, pl. XI, fig. 1, 1836. Miers, Challenger Rept., Zool., XVII, p. 87, 1886.

Mithraculus nodosus White, Cat. Brit. Mus. Crust., p. 7, 1847. Stimpson, Amer. Jour. Sci., XXIX, p. 132, 1860. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 108, pl. XXIII, fig. 5, 1875.

A single soft-shell specimen of a male without chelipeds was collected at the Chatham Island, Galapagos Archipelago, by Dr. W. H. Jones, U. S. Navy (13873).

Previously recorded from Chili.

Mithrax cristulipes (Stimpson).

Teleophrys cristulipes Stimpson, Ann. Lyc. Nat. Hist. N. Y., VII, p. 190, pl. II, fig. 2, 1860; Amer. Jour. Sci., XXIX, p. 133, 1860. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 113, pl. XIX, fig. 2, 1875.

Mithrax (*Teleophrys*) *cristulipes* Miers, Jour. Linn. Soc. London, XIV, p. 667, 1879. Pocock, *op. cit.*, XX, p. 508, 1890.

? *Mithrax cristulipes* Miers, Challenger Rept., Zool., XVII, p. 87, 1886.

Two specimens, male and female, were collected at Rio Formoso, Pernambuco, Brazil, by R. Rathbun during the Hartt explorations of 1875–'77. The types from Cape St. Lucas, said to be in the Smithsonian Institution, are not extant. California and the Bay of Panama are also given as localities for this species. Mr. R. I. Pocock, *loc. cit.*, gives a detailed description of a specimen found at Fernando de Noronha, which he doubtfully refers to this species.

The male from Pernambuco agrees with his specimen in nearly every detail. The tubercles of the antero-lateral margin are very small. The merus of the cheliped is furnished below with three small teeth. There is one minute tooth on the middle of the pollex. The teeth of all the legs are much smaller and less conspicuous than in the figures of *cristulipes*. The female has smaller chelipeds, fingers less gaping, two small teeth on the pollex in the gape, and no teeth on the lower margin of the merus.

As this Museum possesses no specimens from the west coast of America, and as the individuals at hand are more or less imperfect, the writer is unwilling to designate them as a distinct species.

Mithrax sp., Miers.

Op. cit., p. 89, pl. X, fig. 3.

An immature female collected off Cape Catoche, Yucatan, lat. 22° 18′ N., long. 87° 04′ W., 24 fathoms, station 2365, by the U. S. Fish Commission, 1885 (16052), apparently belongs to the same species as the young specimens described by Miers from Fernando Noronha, 7 to 20 fathoms. As our specimen is no larger than those collected by the *Challenger*, and has only one cheliped and one of the first pair of ambulatory legs, I prefer not to give it a name, hoping that at some future time more perfect specimens may be obtained.

It agrees with the specimens described in all essential particulars. The tubercles of the frontal region are, however, not apparent. The tooth at the antero-external angle of the basal joint is sharp and curved. The ambulatory leg is bordered above and below by a thin lamellate crest cut into teeth, which are arranged almost as in the figure cited. This crest is most noticeable on the meral joint. The teeth of the merus of the cheliped are also thin, and partake of the same character.

Thoe puella Stimpson.

Thoe puella Stimpson, Ann. Lyc. Nat. Hist. N. Y., VII, p. 178, 1860. A. Milne Edwards, Miss. Sci. au Mexique, pt. 5, I, p. 122, pl. XIX, fig. 3, 1873.
Pisa latipes (Desbonne and Schramm, Crust. de la Guadeloupe, p. 19, 1867.)

The length of the largest specimen, a female, is 11.7 millimeters; width, 10 millimeters. The merus of the last pair of ambulatory legs is dilated outwardly, but to a less extent than in the first three pairs.

RECORD OF SPECIMENS EXAMINED.

Key West, Florida; H. Hemphill, 1885 (14442), (Union College Coll.).
Jamaica; T. H. Morgan, 1891.
St. Thomas; U. S. Fish Commission, 1884 (16201).

Other localities for this species are Tortugas and Guadaloupe.

LIST OF SPECIES OF PERICERIDÆ NOT REPRESENTED IN THE COLLECTION OF THE U. S. NATIONAL MUSEUM.

WEST INDIAN REGION.

Lissa bicarinata Aurivillius ..... St. Barthelemy
Leptopisa sctirostris Stimpson ..... Tortugas
Sisyphus compressus Desbonne and Schramm ..... Guadaloupe
Pericera spinosissima Saussure ..... West Indies
Macrocœloma diacantha (A. M. Edwards) ..... Majores, 12 fathoms
lævigata (Stimpson) ..... St. Thomas; Guadaloupe
Othonia quadridentata Miers (=? *quinquedentata* Aurivillius; St. Thomas) ..... West Indies
lævigata A. M. Edwards ..... West Indies
Mithrax cornutus Saussure ..... West Indies; Florida Straits to 589 fathoms; also Bahia
depressus A. M. Edwards ..... Guadaloupe; Woman Key
lævimanus Desbonne and Schramm ..... Guadaloupe
leucomelas Desbonne and Schramm ..... Guadaloupe
nudus A. M. Edwards ..... Guadaloupe
(*Nemausa*) *rostrata* A. M. Edwards ..... Gulf of Mexico; Caribbean Sea to 163 fathoms.
holderi Stimpson ..... Tortugas
ruber (Stimpson) ..... Cuba

EAST COAST OF SOUTH AMERICA.

Libinia brasiliensis (Heller) ..... Brazil
coccinea Dana ..... East coast of Patagonia, 30 fathoms
gibbosa A. M. Edwards ..... Brazil
spinosa M. Edwards ..... Brazil; Patagonia; also Chili
ferreiræ Capello ..... ? Brazil
Macrocœloma concava Miers ..... Bahia; Fernando Noronha, 7 to 20 fathoms

WEST COAST OF NORTH AMERICA.

Anaptychus cornutus Stimpson.....Gulf of California
Microphrys depressa (Lockington).....Lower California
error Kingsley.....Lower California
platysoma (Stimpson).....Lower California
tumidus (Lockington).....San Diego, Cal.; Lower California
(=*Perinea*) *tumidus* (Dana).....Sandwich Islands
Macrocœloma heptacantha (Bell).....Puerto Portrero, Central America
villosa (Bell).....California; Cape St. Lucas; also Ecuador
Othonia picteti Saussure.....Mazatlan
Thœ sulcata Stimpson.....Cape St. Lucas; Mazatlan; Gulf of California
Mithrax areolatus Lockington.....Gulf of California
armatus Saussure.....Mazatlan
pygmæus Bell.....Panama, 10 fathoms
triangulatus Lockington.....Gulf of California
trigonopus Cano.....Panama
tuberculatus Stimpson.....Cape St. Lucas; California; Mazatlan; also St. Barthelemy (Aurivillius).

WEST COAST OF SOUTH AMERICA.

Libinia gracilipes Miers.....Coast of Chiloe, 45 fathoms
smithii Miers.....Coast of Chiloe, 245 fathoms
rostrata Bell.....Peru
subspinosa Streets.....Chili
Pericera orata Bell.....Galapagos Islands
Microphrys aculeatus (Bell).....Galapagos Islands
weddellii M. Edwards.....Peru; also West Indies
Othonia quinquedentata Bell.....Galapagos Islands; Panama
sexdentata Bell.....Galapagos Islands; also Cape St. Lucas
Thoe crosa Bell.....Galapagos Islands; Panama
Mithrax rostratus Bell.....? West coast of South America
ursus Bell.....Galapagos Islands; Chili
tumidus Cano.....Payta, Peru

EAST INDIAN REGION.

Pyria pubescens Dana.....Fiji or Tongatabu
Cyphocarcinus minutus A. Milne Edwards.....Madagascar
Podohuenia erythræa Cano.....Red Sea
Tiarinia elegans Haswell.....Australia
mammillata Haswell.....Australia
spinosirostris Haswell.....Cape Grenville; Torres Straits
angusta Dana.....Sooloo Harbor
gracilis Dana.....Sooloo Sea
verrucosa Heller.....Nicobar Island
depressa Stimpson.....Ousima
spinigera Stimpson.....Ousima; Tanegasima
tiarata (Adams and White).....Philippine Islands
sctigera (Adams and White).....Philippine Islands
Tylocarcinus styx (Herbst).....Fiji; Mauritius; Jedda; etc.
gracilis Miers.....Eastern Seas
Macrocœloma trigona (Dana).....Fiji
Entomonyx spinosus Miers.....Western Indian Ocean, 19 to 24 fathoms
Cyclocœloma tuberculatum Miers.....Amboina
Parathoe rotundata Miers.....Fiji; Port Curtis; Suez Gulf

LOCALITY UNKNOWN.

Paramaya dehaanii White.

EXTRACT FROM THE UNPUBLISHED REPORT OF DR. WILLIAM STIMPSON, ON THE CRUSTACEA OF THE NORTH PACIFIC EXPLORING EXPEDITION, 1853 TO 1856.

Tiarinia cornigera (Latreille).

Our specimens differ from those described and figured by Dana in having, at the summit of the intestinal region, one very large and two inconspicuous tubercles, instead of three of equal size. They are also much larger, some being nearly 2 inches in length.

They are found on the reefs at low-water mark, and were collected at the Amakirrima Islands by the officers of the steamer *John Hancock*, and by myself at Loo Choo and Ousima.

Tiarinia depressa Stimpson.

(Plate XL, fig. 1.)

Carapax in shape much like that of *T. cornigera;* proportion of breadth to length, 1 : 1.5; form depressed; upper surface with tubercles less numerous and more flattened than in the *cornigera*. There is a small marginal spine on each side at the branchial region, above which an arc of four depressed warts extends around the side; the first (posterior) one largest and placed a little behind the level of the trituberculated cardiac protuberance; the fourth and smallest is near the anterior extremity of the branchial region, with a still smaller one before it. A submarginal channel of some depth passes around behind, above the intestinal region. Posteriorly, at the upper or intestinal margin, there is a subtriangular median tubercle, with a smaller trilobate one on either side of it; on the lower margin there are four small tubercles.

On the stomachal region there are three warts in the median line, the anterior one smallest and placed some little distance before the others, with a wart on either side of it; behind the posterior one there are two warts placed close together. The ambulatory feet are depressed, smooth above, their edges not spinulose, but sparsely fringed with stout clavate setæ. Only one specimen of this species was taken, a sterile female, the dimensions of which are: length, 0.77; breadth, 0.52; length of a foot of second pair, 0.67 inch.

In the characters of the rostrum, orbits, etc., our species much resembles *T. cornigera*. The tooth at the external angle of the basal joint of the external antennæ is, however, less prominent than in that species, and the rostrum curves upward at its slender tip, where the horns are slightly divergent. It is more depressed than *T. tiarata;* the forks of the rostrum are less divergent; the præorbital spine less prominent, and is wanting in the wooly hairs characteristic of that species.

The specimen was taken at the Island of Ousima, which forms one of the chain connecting southern Japan with Loo Choo.

Tiarinia spinigera Stimpson.

(Plate XL, fig. 2.)

Carapax somewhat elongated, the greatest breadth, excluding spines, being considerably less than the postorbital length. Upper surface not very convex except at the well-developed gastric region; cardiac region, with three tubercles at the summit, placed as usual in the genus; on either side of this on the branchial regions there are three sharp, erect spines, the outer one being lateral a little larger than the others, and somewhat inclined outward. There is a single longish clavate seta at the summit of each spine. Upper posterior margin with seven small spines, the middle one largest at the summit of the intestinal region; lower posterior margin also with seven spines, but of much smaller size. The sides of the carapax, including the hepatic regions, and the posterior half of the upper surface are covered with small, sharp tubercles occupying the interspaces between the spines and larger warts; while the gastric region and parts adjacent on either side, although irregularly protuberant, are nearly smooth. Rostrum sharp and very slender, in length equaling two-thirds of the interorbital width; horns contiguous throughout their length. Præorbital tooth prominently salient, very slender and sharp, curved upward; a single closed fissure separates it from the somewhat prominent postorbital tooth. The basal article of the external antennæ is broader than long; its antero-exterior tooth lies close beneath the præorbital tooth and helps to form the deep tubular orbit, which incloses the eye as in a sheath. The edges of the rostrum and of the external antennæ are, as usual, ciliated; and there are some few crispate setæ on the prominent parts of the carapax anteriorly and at the sides.

In the feet of the anterior pair the carpus and meros are sparingly spinulose above. The ambulatory feet are almost smooth; those of the first pair in the female are scarcely as long as the carapax. The abdomen in the female is tomentose. Two specimens only of this species were found, both females. The dimensions of the largest are: length of the carapax, 0.79; breadth, including spines, 0.57 inch.

This species occurred at the islands Ousima and Tanegasima, of the southern Japanese chain.

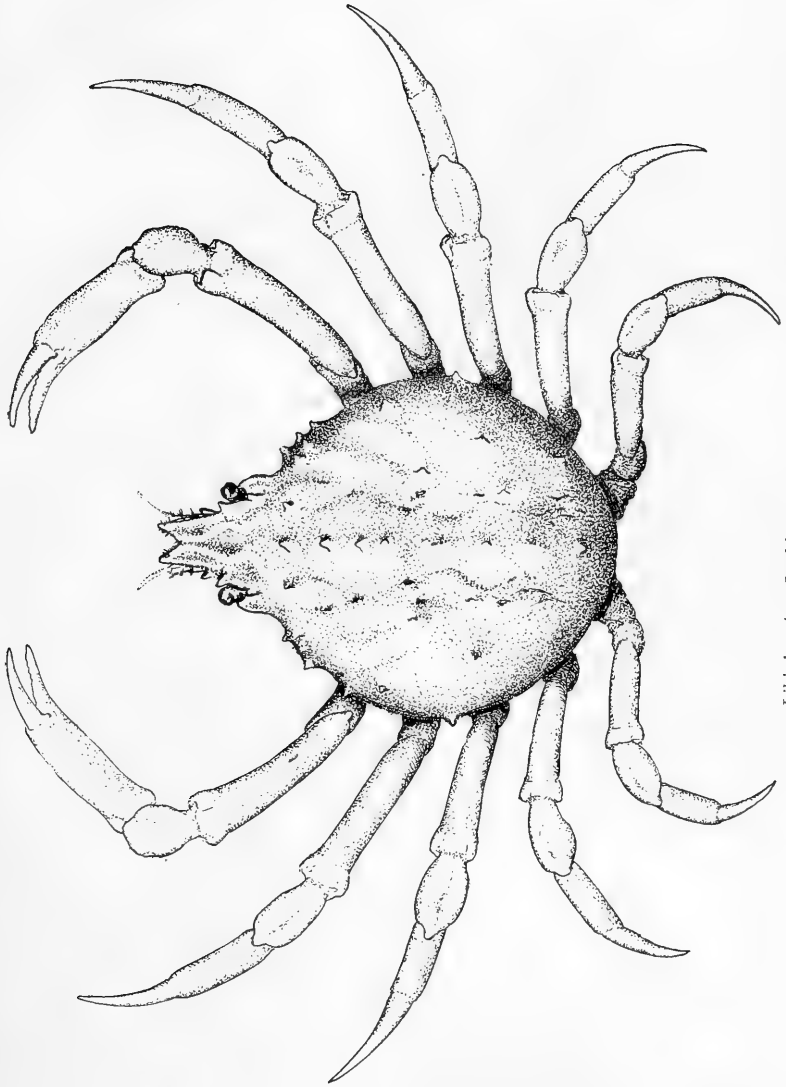
Perinea tumida * Dana.

Crust. U. S. Expl. Exped., I, p. 114, pl. IV, fig. 1, 1852.

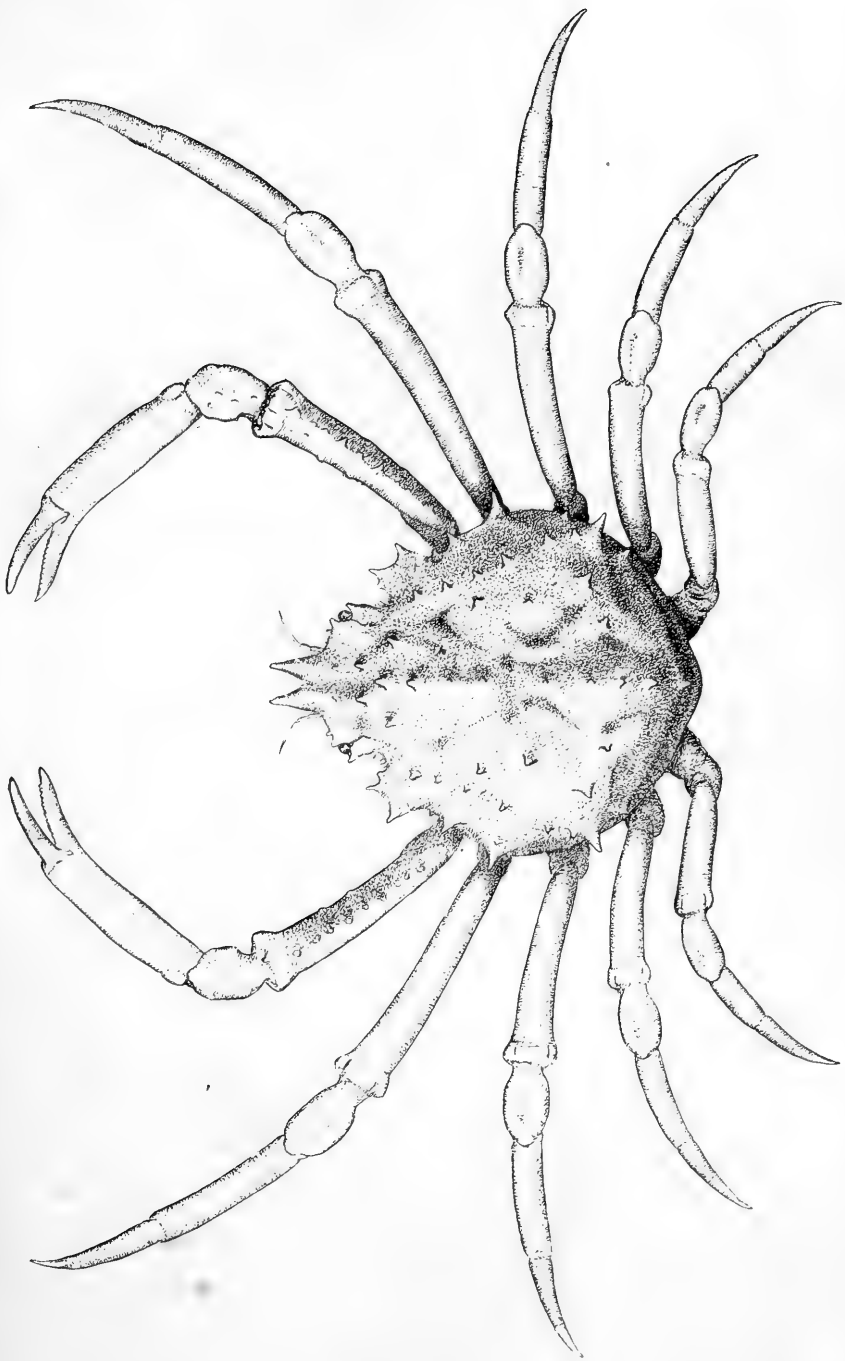
Our specimens agree well with those of Dana, except that in the male the pincers are much smaller and less gaping, while the size of the carapax is the same; this may, however, result from a difference of age and development.

Taken from branches of *Madrepora* found below low-water mark near Hila, Island of Hawaii.

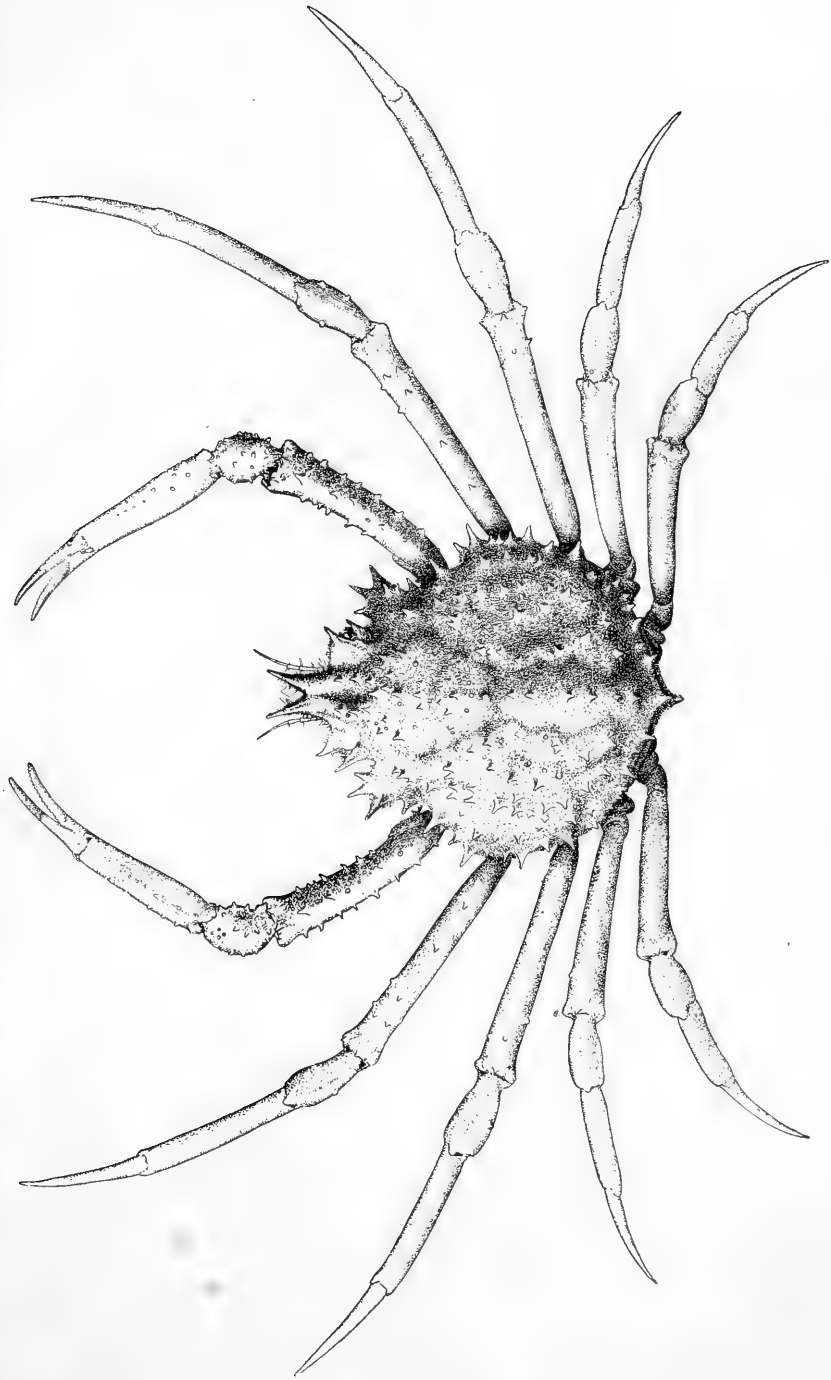
* Now included in the genus *Microphrys*.



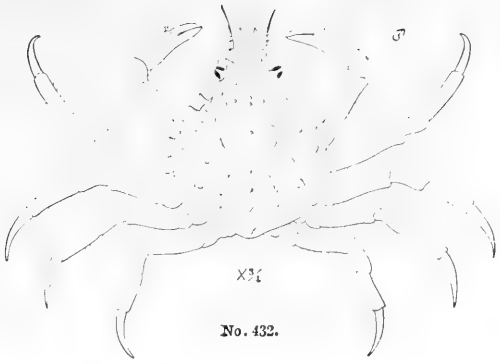
Libinia setosa Lockington, ♂, × about $\frac{2}{3}$.



Libinia macdonaldi, sp. nov., ♂. about ½.



Libinia spinimana, sp. nov., ♂, × about ⅓.



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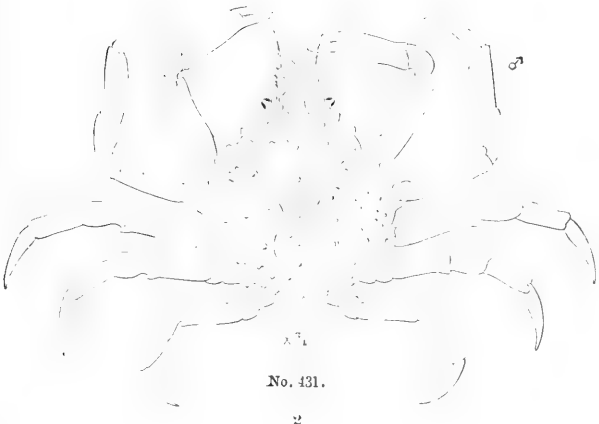

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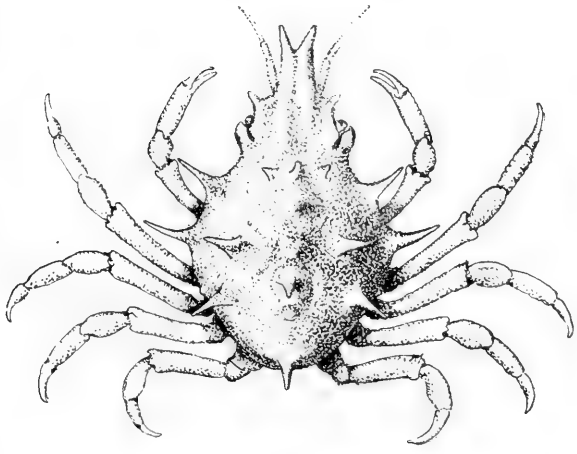

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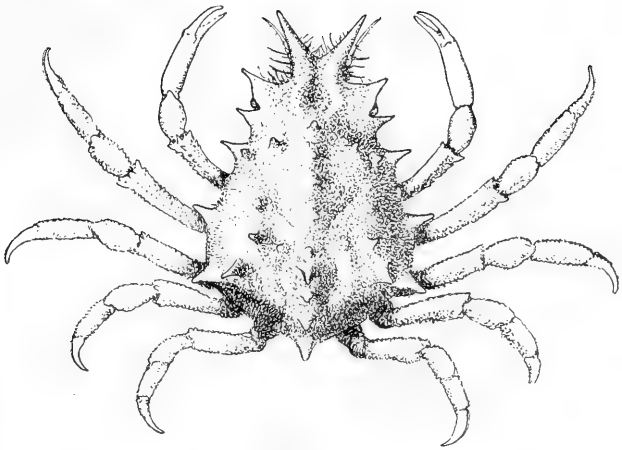
Fig. 1. *Libinia dubia* Milne Edwards, × ¾ of small male.
Fig. 2. *Libinia emarginata* Leach, × ¾ of small male.
Fig. 3. *Libinia mexicana*, sp. nov., young ♂, × 3½.



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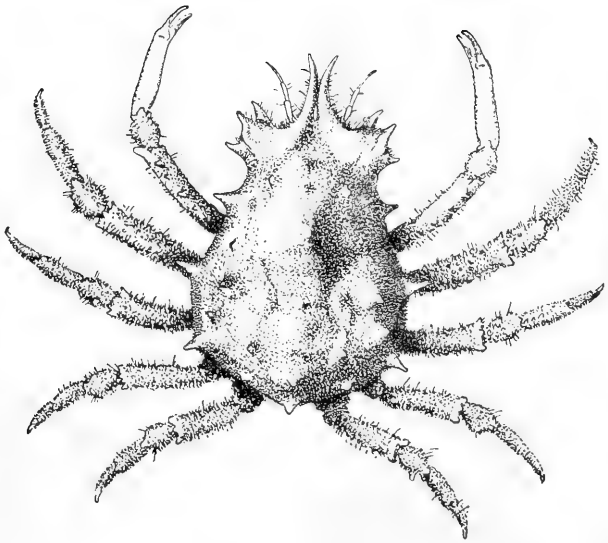

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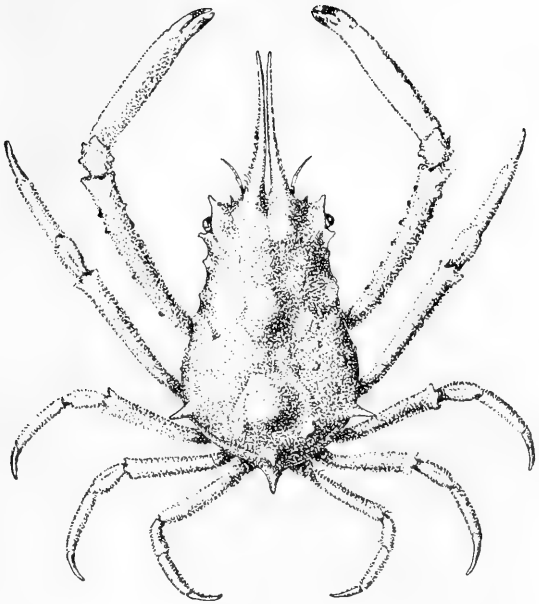
Fig. 1. *Pericera triangulata*, sp. nov., young ♀, × 2⅔.
Fig. 2. *Pericera contigua*, sp. nov., young ♀, × 1⅔.



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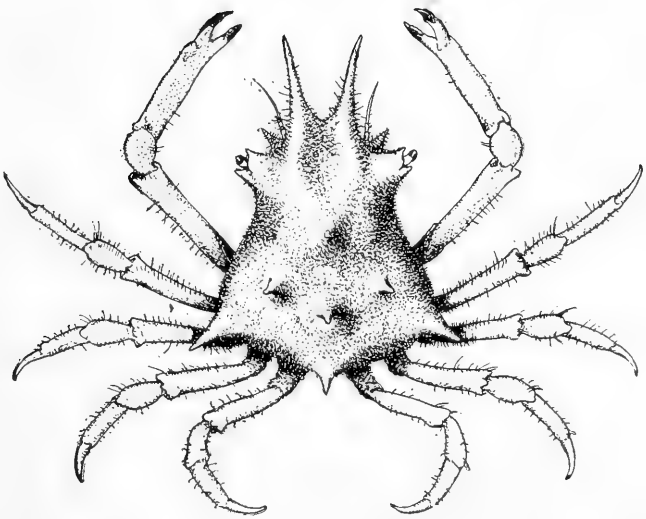
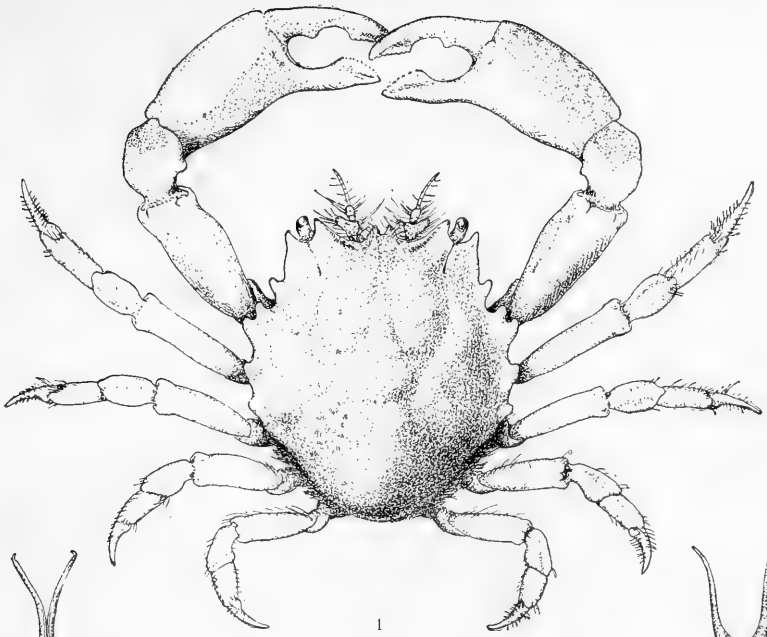


2

Fig. 1. *Macrocœloma tenuirostra*, sp. nov., ♂, × 2¾.
Fig. 2. *Macrocœloma camptocera* (Stimpson), ♂, × about 1½.



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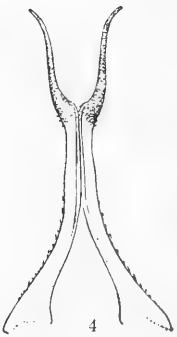

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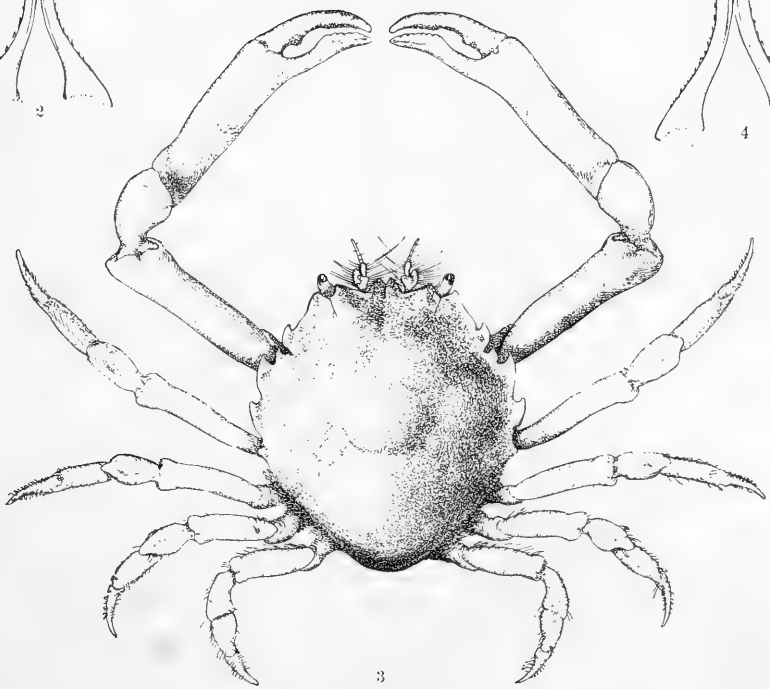
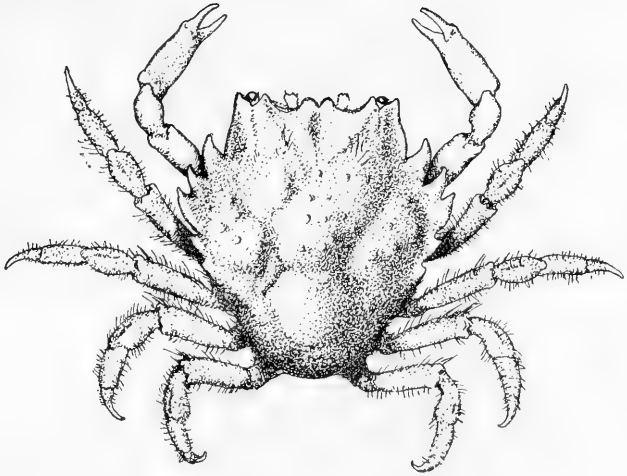
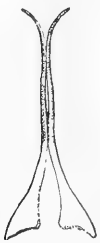


3

Fig. 1. *Othonia aculeata* (Gibbes), ♂, × 1½.
Fig. 2. *Othonia aculeata*, appendages of male abdomen, × 4.
Fig. 3. *Othonia lherminieri* Schramm, ♂, × 1½.
Fig. 4. *Othonia lherminieri*, appendages of male abdomen, × 4.





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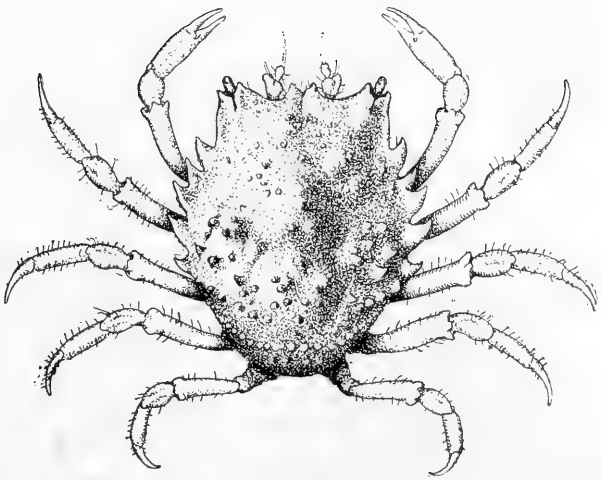
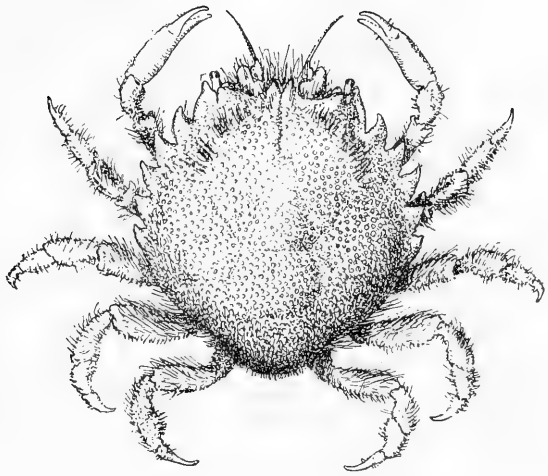


3

Fig. 1. *Othonia carolinensis* sp. nov., ♂, × $2\frac{3}{4}$.
Fig. 2. *Othonia carolinensis*, appendages of male abdomen, × about 5.
Fig. 3. *Othonia nicholsi*, sp. nov., young ♀, + $4\frac{2}{7}$.



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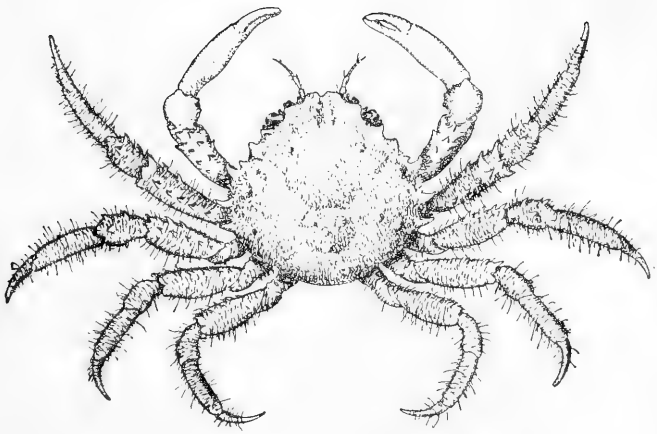

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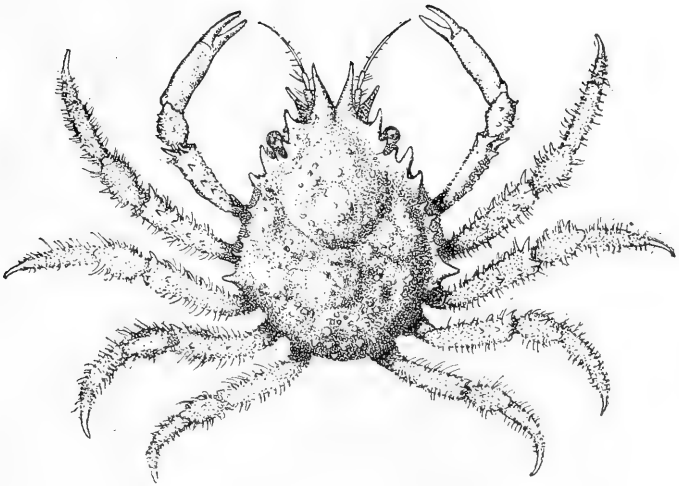
Fig. 1. *Othonia rotunda*, sp. nov., ♀, × about 2.
Fig. 2. *Mithrax braziliensis*, sp. nov., ♂, × 1¼.



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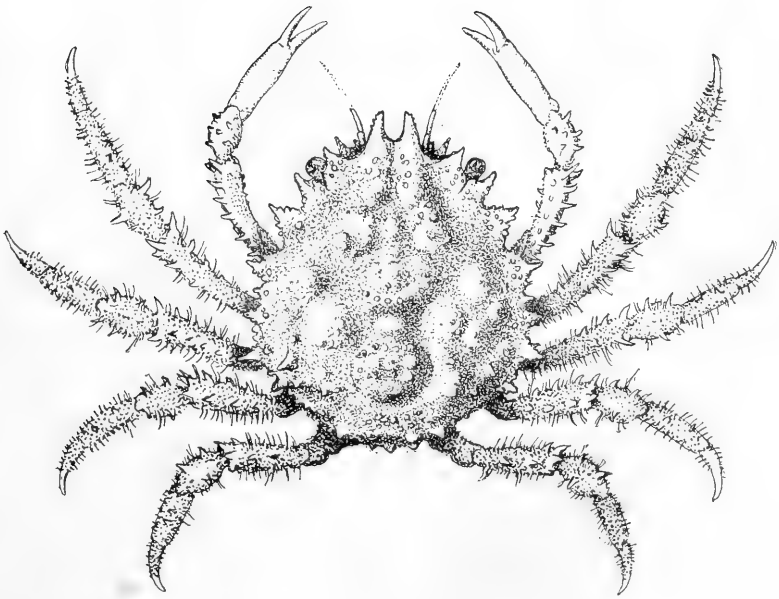
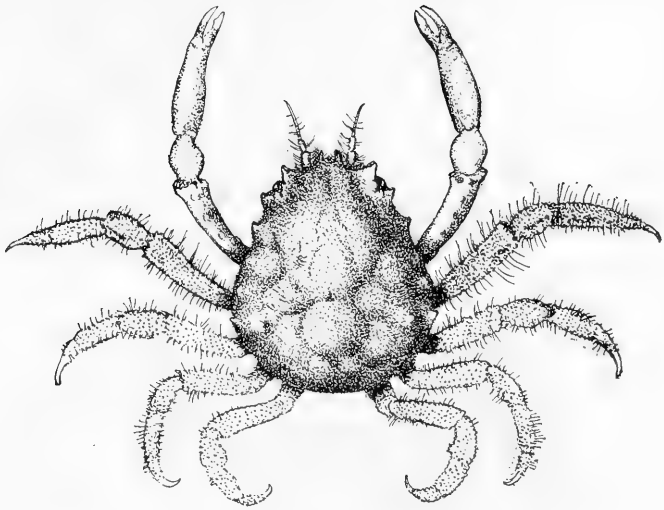


2

Fig. 1. *Mithrax* (*Nemausa*) *acuticornis* (Stimpson). ♂, × 2⅓.
Fig. 2. *Mithrax hemphilli*, sp. nov., young ♀, × 2⅓.



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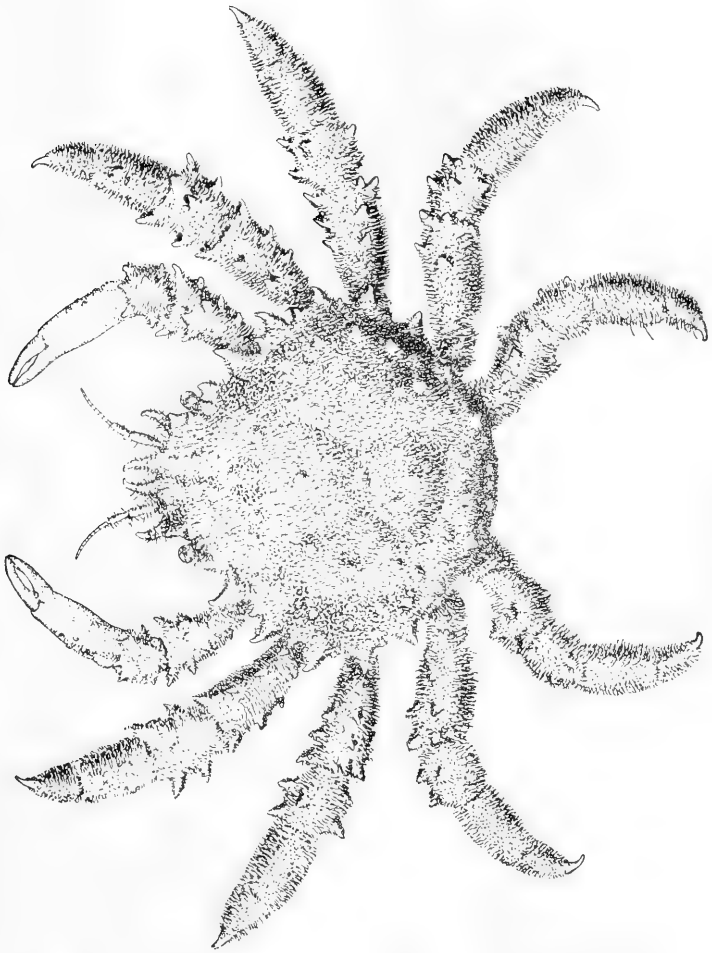
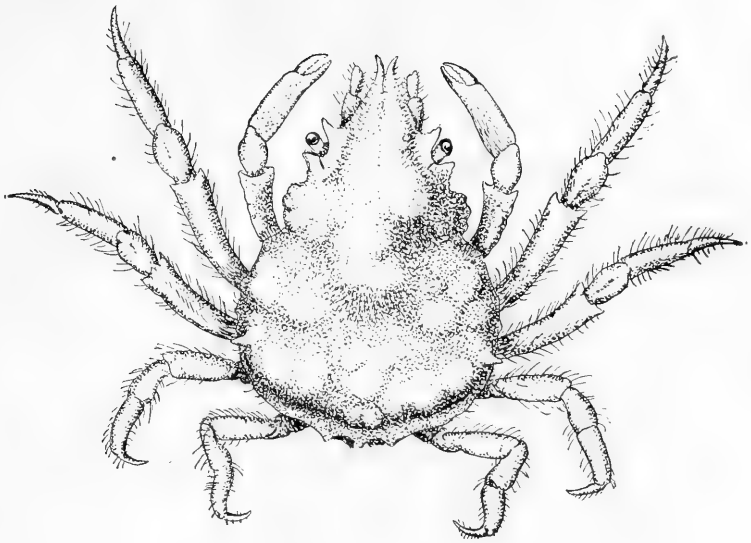
2

Fig. 1. *Mithrax bahamensis*, sp. nov., ♂, × 1½.
Fig. 2. *Mithrax sinensis*, sp. nov., young ♂, × 4.



Mithrax pilosus, sp. nov., ♂, × 1½.



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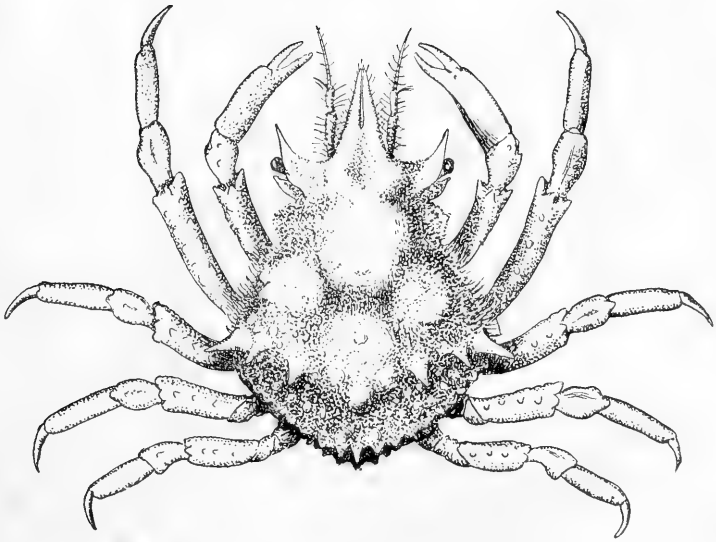


2

Fig. 1. *Tiarinia depressa* Stimpson, ♀, × 2⅔.
Fig. 2. *Tiarinia spinigera* Stimpson, ♀, × 2⅔.

THE EVOLUTION OF HOUSE-BUILDING AMONG THE NAVAJO INDIANS.

BY

R. W. SHUFELDT, M. D.

(With plates XLI–XLIII.)

From November, 1884, until the early spring of 1889 the writer lived at Fort Wingate, a military station in northwestern New Mexico. During the earlier part of this period there was always to be found a floating population of Navajos living on the outskirts of the fort. Including men, women, and children, these varied in number from twenty to a hundred or more, depending upon the time of the year. A few of them, however, remained the year round, and these, as well as the others, furnished ample material for the ethnological study of this interesting tribe. Accounts of many of their simple industries, of their arts and craniology have already been published by the writer, and it is now intended to give the result of my studies concerning their methods of architecture, and the influence which civilization has had upon the mind of these Indians—a contact which has led them to improve their plans of house-building, and has had the effect of bringing about an evolution of the same.

During the early part of the summer of 1885 the Indians who remained all the year round in the neighborhood of Fort Wingate took up their abode on the summit of a barren, rounded hill, situated near the officers' quarters. Here I watched them with increasing interest, as they constructed their first permanent dwellings in this part of the country. Men and women entered upon this labor, though the men did the heavier part of the work.

Having selected a site, more or less circular with a diameter something like 15 to 20 feet, they would clear it of all stone and rubbish, and often to some extent excavate it, or else improve a natural excavation which existed. Next some twenty or thirty logs, usually of pine, are brought, which vary in size from one as big as a bean pole to a piece of timber averaging 8 or 9 inches in diameter. Often these are gathered in the forest, but occasionally the Indians cut them down, using some old condemned ax they have found in the refuse of the post. Branches are also brought, and a thick, clayish mud is mixed close by the nearest running stream or spring of water. All being ready, several of the builders erect a tripod, composed of some of the stouter pieces of timber,

and slightly bury their heavier ends in the periphery of the excavation. This primary framework is now strengthened by adding to it other pieces, care being taken to leave a proper aperture for a door on the side least exposed to the prevailing winds, and an opening at the apex to allow the escape of smoke. Soon there is but little left to do, as far as the woodwork is concerned, except to fill in the interstices between the larger pieces of timber with the lighter poles.

To give the frame additional strength, pieces of rock are now placed here and there, both inside and out, at the lower ends of those pieces of timber which, from some cause or other, are the least secure, or are likely to slip. Plastering with mud is next in order, and this is thickly laid on the outside, filling in as much as possible all the spaces between the logs and poles, and piling it up all the way around the base, externally. This operation is performed with the naked hands, though occasionally a smooth piece of bark may be used in lieu of a trowel, but this is an exception. The top of the doorway is squared off with a stout stick as a crosspiece, and sometimes the chimney is finished up a little with flat stones, as may be seen in the hut in the distance in pl. XLI, and a blanket is invariably hung as a door. A few branches are now laid all over the outside, as a simple means of protection against dogs and children, who might otherwise run over the fresh mud. These are eventually blown away, or burned inside. Often an old condemned piece of canvas comes into play, being laid over the exterior as far as it will go, and admirably protecting the plaster against the elements. This finishes the construction of the primitive Navajo house, and in the spring of 1885 these Indians had advanced no further in the construction of their dwellings.

In pl. XLI a Navajo and his sister are seen in the doorway of one of the huts heretofore described, and it will be seen that the woman is dressed in a somewhat civilized costume. She is the only Navajo squaw in that part of the country that ever did so, and she both received and courted the attention of the soldiers of the garrison, and was withal a remarkable character.

During the following year some of these Navajos commenced building in a little more sheltered situation, close to but to the westward of the fort. Although they used similar materials to those mentioned in my previous description, the form of the house was by no means the same. Its sides upon the east and south were vertical; the roof was horizontal, while its side to the west was slanting. Moreover, they had gotten hold of some old pieces of stove joints and passed them to the rear outside where their free end was again turned upwards, and there plastered and stoned up as a chimney (see pl. XLII). In many particulars this house was far more comfortable and roomy, and as a study it was exceedingly interesting, for it not only showed improvement, but was remarkable, inasmuch as it combined that improvement with their pristine notions of house-building, which we see in the slanting west side of the structure. In fact it would be difficult to conceive of a

structure standing so immediately betwixt what these Indians first erected as a house and that which still remains to be described.

There are some interesting figures standing about the doorway of the house shown in the second plate. The man with his hand resting upon his left hip is "Navajo Jake," the celebrated silversmith of the tribe, whose work has formed the basis of one of the reports of the United States Bureau of Ethnology. Charlie stands with his carbine in the hollow of his arm; he is a well-known Government Navajo scout. The man with the blanket over his shoulders is an old chief, long since retired; the others are also Navajos. The woman with the baby in the cradle is the subject of one of the illustrations to a paper which has recently been accepted for publication by the Popular Science Monthly, of New York.

Near the house we have just described the Navajos built another some time during the spring of 1888, and it showed in its every detail a marked advance in house-building. It had but one room, to be sure, but it would accommodate a family comfortably, living as these people are accustomed to do indoors. All its sides were vertical and built regularly of heavy pieces of fine timber, the interstices among them being carefully sealed with a generous supply of mud plaster. The roof had a moderate pitch to it, and was built of boards nailed on to cross rafters, the whole being heavily covered over with mud. (Pl. XLIII.)

Small strips of board were used in other parts, as over the door and elsewhere, while some heavy pieces of timber supported the structure on the outside as struts. Then the door itself was a real door on hinges which they had obtained somewhere and hung with no little ingenuity. They had also secured an old condemned stove with its joints of pipe from the fort, and had set it up quite comfortable inside.

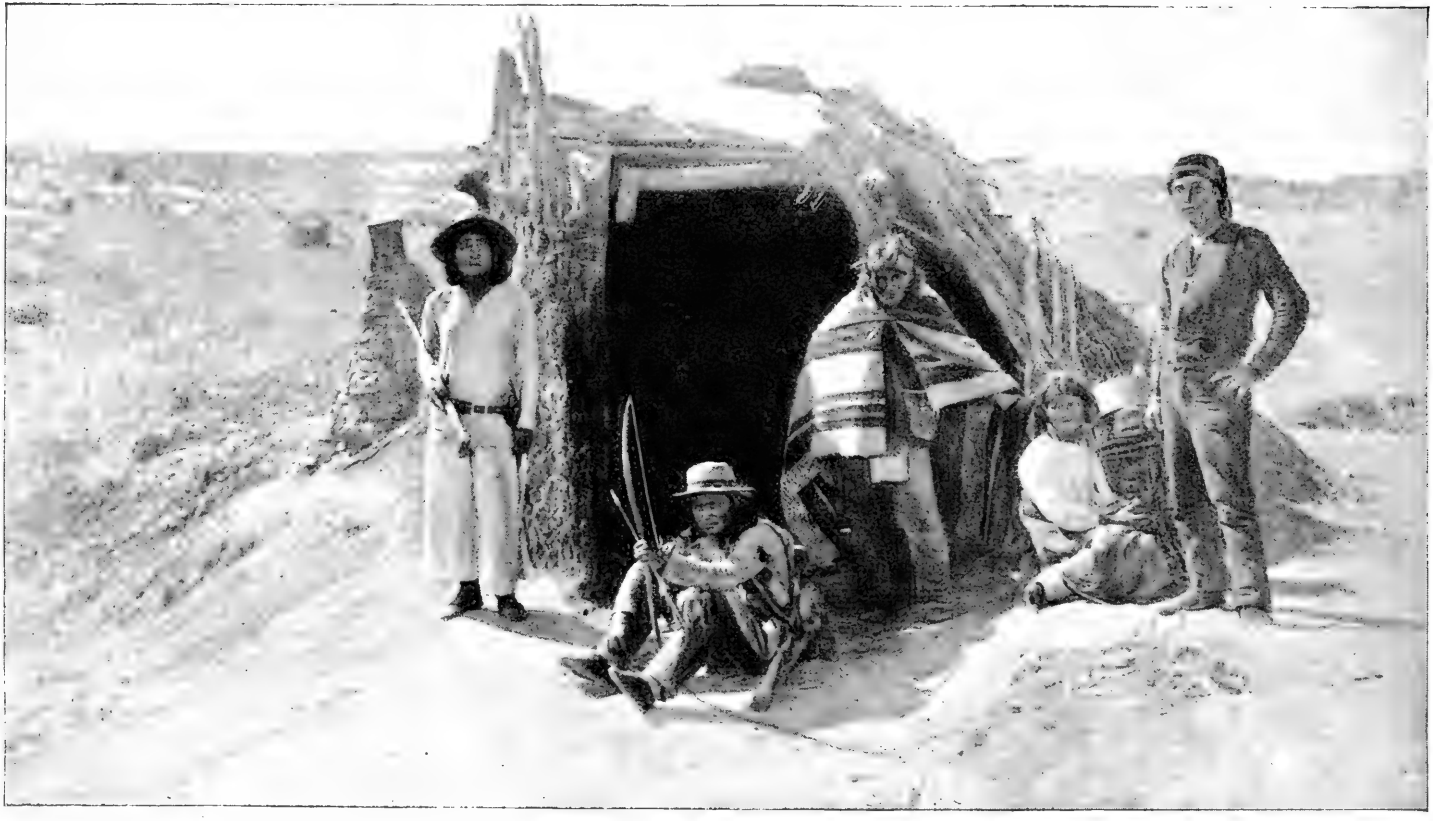
The floor was of earth, but level, hard, and dry, and here and there about the interior were evidences of a growing notion of comfort.

In this picture we have the family fully represented. The man is standing with his hand resting upon the door, his wife is seated outside weaving a belt, and at her side is her baby boy, seated upon a blanket of her own manufacture. The whole is a scene of marked naturalness and great interest, and one that rarely rewards the labors of the photographer among these people, who are very averse to having their pictures thus taken, and one must know them well and be liked by them before he can hope to succeed. It was months before they became in any way accustomed to my camera. A group of gamblers never would permit the exposure to be made; they invariably rolled themselves up in their blankets, and lay as quiet as so many armadillos until the enemy had departed. By tact and perseverance, however, a great many valuable negatives were procured by the writer, which depict all manner of scenes from the daily life of these Indians.

Nearly all the Government and other buildings at Wingate are built of adobe bricks, and these bricks are made in the immediate vicinity of the post by the Navajos, who are hired for the purpose.

Often groups of these Indians have watched the erection of a large two-storied house built with these bricks, and yet I have never heard any of them say that it was their intention to use the same kind of materials in building their own houses. There are two things which probably deter them from doing this, and from following the example of the white man, one of which is the dread of criticism, and the other a fear, perhaps, of exciting his jealousy and being prohibited the use of such material. Were they to attempt to erect houses of brick, I think they would doubtless succeed.

PRIMITIVE NAVAJO INDIAN HOUSE AT FORT WINGATE, NEW MEXICO. 1885, WITH A SECOND ONE IN THE DISTANCE.
From a photograph by the author.



NAVAJO INDIAN HOUSE, SHOWING IMPROVEMENT IN BUILDING, 1886, NEAR FORT WINGATE, NEW MEXICO.
From a photograph by the author.

NAVAJO HOUSE AT FORT WINGATE, NEW MEXICO, SHOWING IMPROVEMENT IN BUILDING.

From a photograph by the author.

NOTES ON FISHES COLLECTED IN MEXICO BY PROF. ALFREDO DUGÈS, WITH DESCRIPTIONS OF NEW SPECIES.

BY

TARLETON H. BEAN, M. D.,

Ichthyologist of the United States Fish Commission.

(With Plate XLIV.)

The U. S. National Museum received from Prof. A. Dugès, August 24, 1891, a small but very interesting collection of fishes, including three species which appear to be new to science, and which are described in the following paper. Among these fishes are two examples of *Lampetra spadicea* of much larger size than any previously obtained, and which show some very interesting variations from the types. The species of *Acara* from the region Huazteca Potosina, in the province of San Luis Potosi, Mexico, is interesting because it appears to be the first one of its group from the locality. It is rather curious that the name Mojarra should be held in common by this fish and the species of *Gerres*.

Lampetra spadicea Bean.

Two examples, 10⅓ and 10½ inches long, Catalogue No. 43766, Collector's No. 177; from Tanganzicuaro.

The length of the head is one-eighth of the total, and the diameter of the eye is contained four and two-third times in the length of the snout. In the longer individual the maxillary tooth has two minute cusps between the large ones, but neither of these is median. The mandibulary plate has nine cusps, of which five are larger than the intervening ones. The teeth around the margin of the disk are reduced to two rows posteriorly. In the shorter example, which has more of a bluish tint overlying the chestnut of the upper parts, the maxillary tooth has one minute supplementary cusp, not median in position. The mandibulary plate has nine cusps, as in the larger individual.

Algansea dugèsi, new species. (Plate XLIV, fig. 1.)

This species is related to *A. australe* Jordan, from which it differs in its much smaller scales.

The types of the species are catalogue Nos. 41818 and 43764, U. S. National Museum. They were collected by Prof. A. Dugès, of Guana-

juato, Mexico. The first is No. 169 of his series, and the other is 174. No. 169 was taken at Guanajuato and No. 174 in Lake Yuriria. The length of No. 41818 is 7 inches to the base of the caudal, the total length 8⅜ inches. The smaller example is 5½ inches to the caudal base; total length, 6½ inches. The height of the body in the larger specimen equals the length of the head, and one-quarter of the total without caudal. In the smaller example the height is contained four and one-half times in the same length. The least depth of the tail is from one-half to two-fifths that of the greatest depth. The eye is placed near the top of the head; its diameter is contained one and one-half times in the length of the snout and from five to five and a half times in the length of the head. The lower jaw is slightly included; it has a small knob at the symphysis. The maxilla reaches to below the front of the eye. The dorsal origin is midway between the tip of the snout and the base of the caudal (over the twenty-eighth scale of the lateral line). Its base equals two-ninths of its distance from the tip of the snout. The longest ray is two-thirds as long as the head and more than twice as long as the last ray. The scales are very small and much crowded anteriorly, larger behind. The ventral origin is under the middle of the dorsal base; the fin does not reach to the vent, its length equal to that of the postorbital part of the head. The pectoral is as long as the head without the snout. The anal origin is distant from the ventral origin a space nearly equal to the length of the head. The length of the anal base is about equal to that of the snout. The longest anal ray equals the length of the ventral, and fully twice the length of the last ray.

D. ii, 7; A. ii, 6; V. 9; P. 16.

Scales 18, 69 to 72, 13. The lateral line is sharply decurved over the pectoral, and, in the straight portion, is below the median line of the body. The caudal is large and well forked, its middle rays three-fifths as long as the outer.

The color is dusky brown, the cheeks and opercles silvery, and the belly whitish. A very indistinct dark spot at the caudal base, deeper than long, its depth about equal to the diameter of the eye. The dorsal, caudal, and pectoral fins dusky; the pectorals, ventrals, and anal mingled with silvery. Teeth 4—4. The three largest with a broad grinding surface, and the second, third and fourth with a slight hook. On the other side of the same example all of the teeth have a well developed grinding surface. Gill-rakers, four above the angle and fifteen below; the longest about one-third as long as the eye.

The species is named in honor of its discoverer, Prof. A. Dugès.

Hudsonius altus Jordan.

A single example of this species, catalogue No. 43763, collector's No. 175, obtained at Lake Yuriria, Mexico, is 6½ inches long. The eye is nearly as long as the snout and two-ninths as long as the head, which

is one-fourth of the total without caudal. The depth is two-sevenths of the same length. The dorsal origin is over the seventeenth scale of the lateral line and immediately over the ventral origin. The ventral reaches to the vent.

D. iii, 7; A. iii, 7. Scales, 9—45—5. Teeth 4—4, scarcely hooked; a narrow grinding surface developed on three of them.

Fundulus robustus, new species. (Plate XLIV, fig. 2.)

The types of the species are numbers 43760, U. S. National Museum, collector's No. 173, and 43762, the first being a female and the other a male.

The length of the female to the base of the caudal is 107 millimeters; total length, 126 millimeters. The greatest height of the body at the origin of the ventral (37 millimeters) is slightly more than one-third of the length without caudal. The length of the head is a little less than one-third of the total without caudal. The least depth of the caudal peduncle is one-half of the greatest depth of the body. The head is broad, the distance between the eyes equal to the length of the eye and the snout combined. The top of the head is nearly flat, and the nape is moderately elevated. The eye is as long as the snout, its length contained from four and one-half to five times in that of the head. The mouth is very obliquely placed, and the lower jaw is longer than the upper. The end of the maxilla reaches to below the front of the eye. The intermaxillary is very protractile; the width of the mouth is one-third the length of the head. Teeth in the jaws in narrow bands or biserial, all conical, the outer series somewhat enlarged. Gill-rakers short, stout, about nineteen on the first arch. There are thirteen scales between the upper angle of the gill opening and the origin of the dorsal. The dorsal commences nearly midway between the tip of the snout and the end of the tail.

The dorsal base is one-half as long as the head and a little longer than the longest dorsal ray. The ventral origin is midway between the tip of the snout and the base of the caudal. In the male the fin reaches to the vent and nearly as far in the female. The anal origin is under the middle of the dorsal base, and the last ray is under the last dorsal ray. In the female the first six rays are short and stiff, and the genital opening is immediately in front of, but disconnected from, the anal fin. The anal base is nearly as long as the longest anal ray and one-third as long as the head. In the male the middle caudal rays are one-half as long as the head; slightly shorter in the female. The longest dorsal ray (fifth) in the female is considerably more than one-half the length of the head, while in the male it is considerably less than one-half length of head.

B. 5; D. 14; A. 16; V. 6; P. 16. Scales, 16—38.

The color at present is uniform pale brown; fins unspotted and the opercle with a golden tint.

In radial formula and number of scales this species is apparently nearest to *F. labialis* Gthr., but in *labialis* the height of the body at the base of the pectoral is contained four and one-half times in the length without caudal, while in the species here described it is contained three times. In *F. labialis* the head forms one-fourth or less than one-fourth of the total without caudal, while in this species it is fully one-third of this length.

Additional examples of this species were obtained by Prof. Dugès, being number 37834 U. S. National Museum, a single specimen 5 inches long; and number 41973, five examples, the largest 4 inches long and the smallest $2\frac{1}{2}$ inches. In these five specimens the differences separating *F. robustus* from *F. labialis* Gthr. are found to be constant.

Characodon variatus Bean.

A single specimen, No. 43761 U. S. National Museum, collector's No. 184, $2\frac{3}{4}$ inches long, was collected by Prof. Dugès in the State of Guanajuato. With the aid of the numerous additional specimens collected by this gentleman since my description of *Characodon variatus* and *ferrugineus* was published (Proc. U. S. Nat. Mus., 1887, pp. 370–372), I am led to believe that these two species are identical. The sexual differences are very striking. On Plate XX of the volume just mentioned is a female, and fig. 4 the male. In a large series of this species, No. 41813, containing many females, this sex is found to have a narrow dark band along the side usually well developed, and a very distinct broad dark band occupying the middle of the caudal fin, the base and the tip being pale. The dorsal in this sex is bluish, except that there is a narrow pale margin along the top.

It should be stated, also, that my previus opinion as to the identity of *Goodea* and *Characodon* is erroneous, the characters assigned to *Goodea* justifying its separation as a distinct genus.

Acara bartoni, new species. (Plate XLIV, fig. 3.)

The description is based upon four specimens, catalogue number 43765, U. S. National Museum, which were collected in Hauzteca Potosina, a region situated north of the State of Guanajuato, in the State of San Luis Potosi, Mexico. Prof. Dugès thinks this region probably extends eastward to the Hauzteca Grande, in the States of Tamaulipas and Vera Cruz. The common name in the region is Mojarra.

All of the specimens have been eviscerated and have had their gills removed, but as no better individuals are available they must serve for the purposes of this description. The largest example is 7 inches long and the smallest $3\frac{1}{2}$ inches.

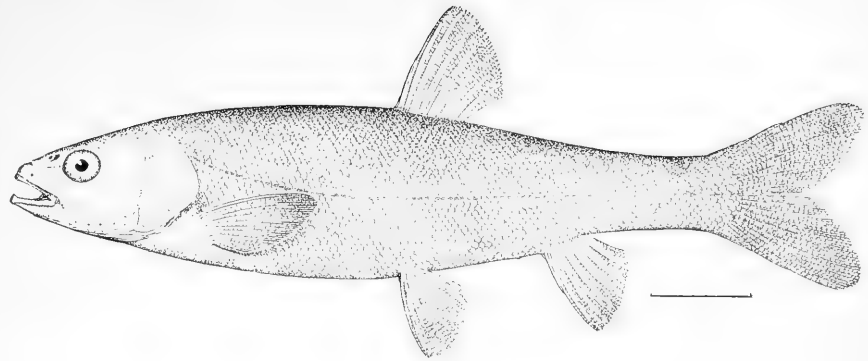
The greatest height of the body is contained two and a third times in the length without the caudal. The two larger examples have the nape strongly arched. The diameter of the eye is contained from four and a half to five and a half times in the length of the head or twice in

the length of the snout. The width of the space between the eyes equals two-thirds the length of the snout. The mouth is very oblique; the lower jaw projects, and the maxilla does not reach to the vertical from the front of the eye. The length of the upper jaw equals two-fifths that of the head. The teeth in the jaws are in bands, the outer series much enlarged and brown at their tips. Head of the vomer much enlarged, but toothless. Palate without teeth. Scales on the cheek in about six series. The dorsal begins over the gill opening, the first spine very short, the second somewhat longer, the length of the spines gradually increasing backward, so that the last and longest spine is nearly one-third as long as the head. The longest soft rays (third and fourth) are nearly one-half as long as the head. The spines of the dorsal are rather slender. The anal origin is nearly under the beginning of the soft dorsal. The fin contains four spines, of which the first is about three-fourths as long as the eye, and the fourth nearly one-third as long as the head. The longest anal ray (fourth) is more than one-half as long as the head. The least depth of the tail equals the length of the snout. The middle caudal rays are slightly longer than the longest anal ray. The pectoral nearly reaches to above the origin of the anal and the ventral reaches to the vent.

There are five or six rows of scales between the origin of the dorsal and the lateral line; eleven between the anal origin and the lateral line, counting obliquely upward and forward. Scales in L. lat. 34. The line is interrupted under the fourth soft ray of the dorsal and begins on the median line of the tail at a distance below the upper line a little greater than the diameter of the eye.

D. XIV, 11; A. IV, 9.

The color is purplish brown; from the head to the tail there is a broad dark band, which is more or less broken up into separate blotches, the last of which is very distinct at the base of the tail. Fins dusky. In a specimen about 5 inches long the cheeks and snout are profusely covered with minute roundish brown dots.



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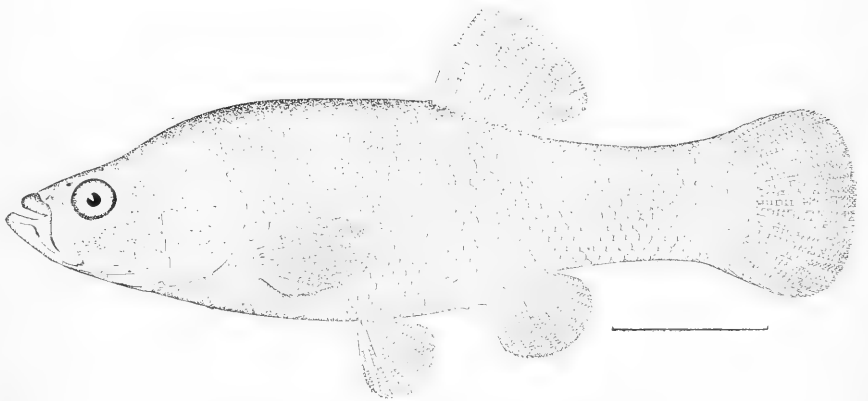

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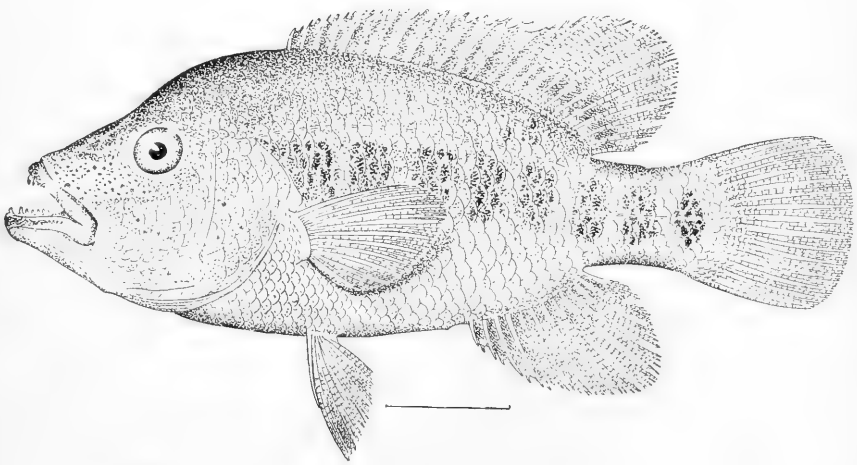


3

Fig. 1. *Algansea dugesi*, new species.
Fig. 2. *Fundulus robustus*, new species.
Fig. 3. *Acara bartoni*, new species.

NOTES ON A COLLECTION OF BIRDS MADE BY MR. HARRY V. HENSON IN THE ISLAND OF YEZO, JAPAN.

BY

LEONHARD STEJNEGER,

Curator of the Department of Reptiles and Batrachians.

(With Plate XLV.)

In response to my request for the loan of material for my proposed manual of Japanese ornithology, several years ago, Mr. Harry V. Henson, then of Hakodate, Yezo, most generously placed in my hands for examination a large and interesting collection made by him in the neighborhood of that town. Since then the U. S. National Museum has acquired this collection by purchase.

My original intention was to enumerate every specimen in the collection, but as it now has become part of our Museum, this plan was given up, especially since press of other work threatened to entirely prevent me from finishing this paper. Consequently, only the more interesting species have been treated of, and, as will be noticed, in a somewhat uneven manner. The various species were written up in a sequence dictated more by the accessibility of the material than with reference to a natural and systematic arrangement, and as several years have lapsed between the working up of species here closely associated, uniformity was unattainable except by rewriting the whole, an undertaking entirely beyond my powers at present. I have thought, however, that it would be better to publish the paper in the present form than to leave it unpublished.

Great credit is due to Mr. Henson for his successful exploits in a locality which has been better worked ornithologically than any other in Japan, and it is to be hoped that this success will encourage him and others to continue the good work. It demonstrates how much is still to be done even in localities which have been considered nearly exhausted We are as yet only laying the foundations of a solid knowledge of the Japanese avifauna. A large amount of material has yet to be collected and *discussed*, and the sooner it is done the better.

The numbers in parentheses following the specific names refer to Blakiston and Pryer's "Birds of Japan."

Colymbus holbœllii (REINH.). (15½)

A young female was shot near Hakodate, March 3, 1884 (U. S. Nat. Mus. No. 120709, H. V. Henson coll. No. 98). Being only the second record of this species in Yezo, it deserves special mention.

Podiceps nigricans (Scop.). (16+16½)

Little Grebe. Kaitsumuri.

1766.—*Colymbus auritus* γ Linn., S. N., 12th ed., I, p. 223.

1769.—*Colymbus nigricans* Scopoli, Ann. I Hist. Nat., p. 77.

1771.—*Colymbus fluviatilis* Tunstall, Ornith. Brit., p. 3 (*nomen nudum*).

1782.—?*Colymbus pyrenaicus* Lapeirouse, K. Vet. Akad. Nya Handl., III, p. 111.

1787.—*Podiceps minutus* Latham, Gen. Synops., Suppl., I, p. 294.—Seebohm, Ibis, 1882, p. 369.—Blakist. & Pryer, Tr. As. Soc. Jap., X, 1882, p. 93.—Blakist., Chrysanth., Nov., 1882, p. 524.—*Id., ibid.*, Jan., 1883, p. 25.—*Id.*, Amend. List B. Jap., p. 32 (1884).

1787.—*Podiceps hebridalis* Latham, Gen. Synops., Suppl., I, p. 294.

1788.—*Colymbus minor* Gmelin, S. N., I, p. 591.—*Podiceps m.* Schlegel, Mus. P. Bas., Urinat., p. 43 (1867).—Seebohm, B. Jap. Emp., p. 367 (1890).

1788.—*Colymbus hebridicus* Gmelin, S. N., I, p. 594.

1790.—?*Colymbus philippensis* Bonnaterre, Enc. Méth., I, p. 58.—*Podiceps ph.* Swinhoe, Ibis, 1875, p. 456.—Blakist. & Pryer, Ibis, 1878, p. 211.—*Id.*, Tr. As. Soc. Jap., VIII, 1880, p. 181.

1804.—*Colymbus erythrocephalus* Hermann, Observ. Zool., I, p. 151.

1831.—*Podiceps pygmæus* Brehm, Handb. Vög. Deutschl., p. 966.

1842.—*Sylbeocyclus europæus* Macgillivray, Man. Brit. Ornith., II, p. 205.

1855.—*Podiceps pallidus* Brehm, Vogelf., p. 403.

1877.—?*Podiceps albescens* "Mandelli", Blanford, Stray Feath., V, p. 486.

Colymbus nigricans of Scopoli is very often quoted as a synonym of *C. auritus* Lin. (for instance, by Dresser and by Seebohm) but, I think, quite erroneously. Scopoli's diagnosis, "*Duplo minor* priore [*C. auritus*] Remiges secundæ *interno latere semialbæ*," undoubtedly belongs to the present species, and fits no other. The name is evidently derived from Brisson, whose *Colymbus fluviatilis nigricans* by the same authors is correctly referred to the Little Grebe. The confusion has originated with Latham, whose *Podiceps nigricans* (Synops., Suppl., I, p. 294, 1787) is entirely different from Brisson's and Scopoli's *nigricans*, being in fact the winter plumage of *C. auritus*. The name given by Scopoli (1769) is the oldest binominal bestowed upon this species, and should be given precedence over all the other names, even over that of Tunstall, *C. fluviatilis* (1771), which, moreover, is a *nomen nudum*, and, consequently, untenable.

The status of the present species and its subspecies is far from settled yet, and several names have therefore been left out of the above synonymy. Mr. Seebohm (cf. Chrysanth., 1882, Nov., p. 524) indicates several possible subspecies, a black-bellied (not "black-billed," as printed there) race from the Moluccas, another with white wing-speculum from Madagascar and India, and a third one from Asia Minor, remarkable for its short bill. Schlegel (Mus. P. B., Urinat., p. 43) admits that this species in certain localities exhibits light modifications in the colorations of the adults, but regards them as but little constant. His view, that they are "de nulle application générale, puisqu'ils ne sont sensibles que dans les adultes" is considerably at variance with ours and would lead to very curious consequences.

As to the Japanese birds, the general verdict seems to be that they are identical with European specimens, and the material at my command does not contradict it, so that although none of my Japanese specimens are in absolutely full plumage, I feel but little doubt that the above conclusion is correct. The slight differences in the dimensions, as seen in the tables given below, seem to be fully within the limits of individual variation, while in the extent of the black on cheeks and chin, and in that of the white on the wing, I can discover no difference.

I. *Japanese specimens.—Measurements.*

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing	Exposed culmen.	Tarsus.	Middle toe with claw.
U. S. Nat. 109472	.....	♂ ad.	Tokio, Hondo	Apr. 5, 1883	101	19	38	47
U. S. Nat. 91509	Jouy, 758	♂ ad.	do	Jan. 27, 1883	101	21	36	46
U. S. Nat. 91611	Jouy, 1035	♀ ad.	Kanagawa, Hondo	Mar. 29, 1883	96	21	36	48
	Stejn. 706	.....	"Japan"	.....	96	19	37	45
Christiania, Norway	Petersen, 60	♂ ad.	Nagasaki, Kiusiu	Oct., 1886	104	20	35	44
U. S. Nat. 120713	Henson, 1381	♀ ad.	Hakodate, Yezo	Nov. 1, 1884	95	18	34	43
U. S. Nat. 120712	Henson, 95	♀ jun.	do	Nov. 2, 1883	105	21	36	48
U. S. Nat. 120711	Henson, 96	♂ jun.	do	Oct. 29, 1883	100	21	38	48

Petersen's Nagasaki specimen differs from all the rest in having the inner web of the secondaries dusky except at base of the inner ones.

II. *European specimens.—Measurements.*

U. S. Nat. Mus. No.	Collector.	Sex and age.	Locality.	Date.	Wing	Exposed culmen.	Tarsus.	Middle toe with claw.
19056	Lazar	♂ ad.	Hungary	.....	95	18	35	47
57313	Schlüter	♂ ad.	Pomerania	.....	96	19	.....	.....
74316	Pearce	♂	Sweet Waters, Turkey	Dec. 8, 1877	91	16.5	34	47
105962	Pluche	♀	Havre, France	Aug. 25, 1876	90	16.5	33	46
105961	....do	♀	.....do	Oct. 30, 1875	94	18	35	47
99587	.....		"Europe"	1871	103	20	.....	.....
23443	Lazar		Hungary	1860	93	18	.....	.....

Urinator pacificus (LAWR.).

A fine adult male of this interesting species opens the series of additions to the Japanese avifauna. It was shot near Hakodate on July 13, 1883, and is, of course, in full summer plumage, in which it can never be confounded with the nearly allied but quite distinct *U. arcticus*, its small size and nearly white occiput and upper hind neck being conspicuous enough.

The lateness of the occurrence of this specimen near Hakodate suggests the possibility of its breeding not far off, and the question then arises whether *U. pacificus* may not be the breeding bird and *U. arcticus*, which also occurs in Japan, the transmigrating species. A male specimen of the latter was also collected by Mr. Henson at Hakodate, May 12, 1883 (No. 120707).

The measurements of this specimen are as follows:

U. S. Nat. Mus. No. 120708; ♂ ad.; Hakodate, July 13, 1883; H. V. Henson Coll. No. 8; wing, 286mm; tail feathers, 49mm; exposed culmen, 51mm; tarsus, 79mm; middle toe with nail, 90mm.

Eurynorhynchus pygmæus (L.). (114)

Five specimens obtained near Hakodate during the fall migration of 1884, 1885, and 1886 show the pretty regular occurrence of this species on the coast of Yezo. The dates cover a considerable range, and are therefore noteworthy.

U. S. Nat. Mus. No.	Henson No.	Sex.	Date.
120589	44	♀	Oct. 8, 1885
120590	45	♂	Sept. 14, 1884
120591	576	♂	Aug. 3, 1885
120592	887	♂	Oct. 7, 1886
120593	972	♀	Oct. 15, 1886

Tringa canutus L. (104½)

U. S. Nat. Mus. No. 120607 (♂; Hakodate, May 6, 1886; Henson coll. No. 1010) establishes the first record of this species in Yezo.

Pavoncella pugnax (L.). (111)

A second specimen from Yezo is of sufficient interest to deserve special mention. It was collected September 1, 1884, near Hakodate (U. S. Nat. Mus. No. 120608; Henson coll. No. 1129).

Terekia cinerea (Güld.). (100½)

The first record of this species in Yezo is made by the four birds in Henson's collection, two males and two females, and the dates of their captures show that this species must be a rather regular visitor during both migrations. The four specimens (Nos. 120618–120621) were collected near Hakodate August 30, 1883; August 24, 1884; September 6, 1883; and May 16, 1884.

On the whole, this species seems to be more common in Japan than would appear from the published records.

Nettion formosa (Georgi). (10)

Two specimens, making the first record of this species from Yezo, collected respectively April 28, 1886 (U. S. Nat. Mus. No. 120673, ♂ ad., Henson, No. 18), and October 11, 1883 (No. 120674, ♀, Henson, No. 35), show that it occurs during both migrations.

Falco rusticolus Lin.

With the exception of the more or less uncertain references to a "*Falco candicans*" or "*Falco gyrfalco*," based upon Japanese drawings, Mr. Henson's specimen is the first record of a Gyrfalcon in Japan. It was shot near Hakodate March 15, 1884, and is nearly, if not fully,

adult, that is, the under side is rather heavily streaked with dusky but with the new feathers of the adult plumage protruding on the rump, consequently in a plumage corresponding to my No. 92721, from Bering Island, May 5, which had the ovaries in such a condition that she was probably going to breed that spring.

Henson's bird agrees in the minutest details with my Bering Island and Kamchatkan birds (Res. Orn. Expl. Kamtsch., etc., pp. 203, 204; Proc. U. S. Nat. Mus., x, 1887, pp. 139–141).

The specimen measures as follows: (U. S. Nat. Mus. No. 120720), ♀ adol.; Hakodate, March 15, 1884; H. V. Henson coll. No. 9): Wing, 400^{mm}; tail feathers, 237^{mm}; chord of culmen from cere, 26^{mm}; tarsus, 65^{mm}; middle toe, without claw, 55^{mm}.

Cuculus kelungensis Swinh. (165)

The three specimens of Cuckoos in the collection represent three different stages of this species. The series is very interesting, inasmuch as it shows that the broadly-barred species is quite as polymorphic as the common European Cuckoo. We have in fact here to deal with a curious kind of dichromatism, the character of which is still wrapped in mystery.

U. S. Nat. Mus. No. 120566, Henson No. 146, Hakodate, August 30, 1884, is a female in the rufous stage or phase, apparently adult. I say "stage or phase," because it is not yet certain whether this peculiar plumage represents a transient stage only or a permanent phase. The facts indicate, indeed, that it is a permanent phase in some individuals, and an intermediate stage in others, for Naumann (Naturg. Vög. Deutschl., v, Pl. 128, fig. 1) figures a female, in transition from the rufous plumage to the typical adult gray garb, while in the text (p. 203) he asserts that he once shot a female cuckoo in the genuine rufous plumage, which was molting into a still brighter rufous one. The observation by Naumann (*loc. cit.*, p. 203) on the European Cuckoo, that the central pairs of the tail-feathers are of more uniform length and less graduated in the rufous birds, seems also to apply to those of *C. kelungensis*.

No. 120568, Henson No. 1194 (Hakodate, September 19, 1884), is a young male of the year in the hepatic stage (back, remiges, and rectrices having numerous distinct rufous bars), molting directly into the typical gray plumage of the adult; while No. 120567, Henson No. 145 (Hakodate, September 29, 1883), is a young male in the purely gray phase, not yet molting.

Caprimulgus jotaka Temm. & Schl. (188)

Three specimens included in the table below. In the young bird the upper and lower tail-coverts, as well as a number of feathers on the hind neck, belong to the first plumage. In general coloration Mr. Henson's Yezo birds agree with others in the National Museum from Hondo, and with a specimen collected by Petersen in Kiusiu.

Caprimulgus indicus, with which *C. kelaartii* seems to be synonymous, is sometimes quoted as belonging to the present species, but a comparison of Indian specimens of the former with the table of dimensions below will show them to be a much smaller species.

Measurements.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.	Total length.
U. S. Nat., 120563.	Henson, 33	♂ ad.	Hakodate, Yezo	Sept. 27, 1885	222	140	10	15	22	....
U. S. Nat., 96118.	Pryer, Bl., 2615	(♂) ad	Yokohama, Hondo.	.....	213	132	11	15	22	....
U. S. Nat., 88702.	Jouy, 602	♂ ad.	Fuji, Hondo	July 26, 1882	213	130	....	16	23	....
U. S. Nat., 91388.	Jouy, 730	♀ ad.	Tate Yama, Hondo.	Oct. 28, 1882	221	132	10	15	22	....
U. S. Nat., 120564.	Henson, 131	♀ ad.	Hakodate, Yezo	Sept. 10, 1884	205	132	10	16	23	....
Christiania, N.	Petersen, 67	(♀) ad	Nagasaki, Kiusiu.	Nov., 1886	214	128	10	.....	23	....
U. S. Nat., 120565.	Henson, 130	♂ jun.	Hakodate, Yezo	Aug. 22, 1885	212	135	9	15	22	....
U. S. Nat., 96117.	Blak., 2079	♂ jun.	....do	Sept. 20, 1876	213	130	....	16	22	275
U. S. Nat., 96116.	Blak., 1481	♀ jun.	....do	Sept., 1874	209	129	8	.....	.....	....
Average measurements of six adults					215	132	10	15.5	22.5	....

Ceryle lugubris (TEMM.). (176)

We retain the name given to this bird by Temminck for two reasons, first because we regard it as distinct from the Himalayan bird, and, in the second place, because *Alcedo guttata* of Vigors (1831) is preoccupied by *Alcedo guttata* of Boddaert (1783) (A. O. U. Code, p. 47, canon XXXIII). Considering the continental bird as distinct, we propose to call it *Ceryle guttulata*, in order not to deviate too much from the name by which it has been universally known.

The chief difference between the Japanese and the continental birds consists in the white coloration being much more extensive in the former than in the latter. The white bands crossing each feather of the upper parts are much broader in *C. lugubris*, being generally of the same width as the dark interspaces, while in the form which we have designated as *C. guttulata* the white cross bands are considerably narrower. This is not only very striking on the upper side of the folded wings, but on closer examination we find that the white cross-bands on the inner side of the primaries are more numerous in the Japanese form, there being at least one more, this one being about midway between the tips and the next band, while in the mainland species, the entire tip is unspotted for twice the ordinary distance between the white bars. The gray ground color of the back, moreover, is considerably lighter in *C. lugubris*.

C. lugubris is usually stated to be larger than the Himalayan birds, but the size of the two forms is practically identical, as will be seen from the appended tables. The alleged distinction in the shape of the

bill will hardly hold, for in the nine specimens before me I can detect no tangible difference.

Mr. Sharpe, in the introduction to his "Monograph of the Alcedinidæ" (p. xxv), says that "should a large Pied Kingfisher be discovered in China, intermediate forms will doubtless be found to connect the two races." Since then Swinhoe found the Spotted Kingfisher at Ningpo, and a beautiful specimen from the same locality is in the National Museum. So far from being intermediate in character, however, the Chinese specimen agrees most minutely with the darkest Himalayan birds. We have, therefore, no hesitation in referring all the continental birds to *C. guttulata*. In view of the very pronounced characters of the Ningpo bird we are not willing to accept a trinominal for the continental bird, which should not rank as *C. lugubris guttulata* until intergradation be satisfactorily proven.

The bill of the Ningpo specimen is absolutely perfect; it is very pointed, and the upper tomium near the point is distinctly and regularly serrate for a distance of about 15mm, showing that this character is not peculiar to the genus *Syma*.

Males and females differ considerably, the former having the under wing-coverts and the axillaries pure white, while in the latter the middle portion of the lining of the wing, as well as the axillaries, are of a bright vinaceous cinnamon.

In Henson's collection is one specimen, U. S. Nat. Mus. No. 120571, ♀ ad., Hakodate, February 1, 1885. H. V. Henson coll. No. 251.

Measurements of Ceryle lugubris.

U. S. Nat. Mus. No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.
114695	Ringer, 26	♂ ad	Kiusiu	Jan. 3, 1887	185	107	57*	13	28
109403		(♂) ad.	Chichibu, Musashi	Dec. 18, 1884	186	111	64	13	28
91576	Jouy, 1053	♂ ad	Kawasaki River, Hondo	Apr. 11, 1883	187	111	61*	13	28
91577	Jouy, 1054	♀ ad	do	Apr. 12, 1883	191	112	61*	13	28
110484	Jouy, 1054	(♀) ad.	do		183	112	60	13	28
120571	Henson, 251.	♀ ad	Hakodate, Yezo	Feb. 1, 1885	190	112	61	14	30

* Bill much worn from digging the nest hole.

Measurements of Ceryle guttulata STEJN.

U. S. Nat. Mus. No.	Collector.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.
101987	Brooks	♂ ad	Chungus, India	May 18, 1871	180	104	65	13	29
101988	Anderson	♀ ad	Kup Kate, India	May 31, 1875	183	109	63	13	29
101989		(♀) ad.	Darjeeling, India		185	110	66	13	30
85709	H. B. Meyer.	♀ ad	Ningpo, China	Feb. 16, 1881	191	107	71	----	------

Jynx torquilla Lin. (174)

When writing my "review" of the Japanese Woodpeckers (Proc. U. S. Nat. Mus., IX, 1886, pp. 102–104) I had to regret my inability to examine Japanese specimens of the common Wryneck, as well as the insufficiency of my material to solve the question whether there are two climatic varieties of this bird separable by the deeper coloration of the alleged southern form.

The five Japanese birds which I have now before me (see table below) prove conclusively to my mind that the difference in coloration is not due either to sex, age, season, or locality, for Mr. Henson has both the pale and the deeply colored form from Yezo. Owston's specimen, from Hondo, is pale, and Petersen's, from Kiusiu, is dark. I am fully convinced that we have only to do with a dichromatism similar to that of the owls, though, as in some of the dichromatic owls, the one or the other phase may predominate in certain localities.

A comparison of the measurements below with those of the Western examples previously given (*tom. cit.*, p. 104) shows that Bonaparte was right in saying that the Japanese Wryneck is smaller than European specimens, though not *much* smaller as he alleges. In point of fact the difference in size between the examples from the two extremities of the Eurasian continent is so trifling that it would hardly do to base a separation of two forms upon that character, the more so as I have specimens of the same sex before me from both localities which are absolutely identical both in size and coloration. I would call attention, however, to the curious uniformity in the size of the Japanese specimens as shown in the table below, with which Capt. Blakiston's experience completely agrees, as in all the five Japanese Wrynecks measured by him the length of the wing was exactly 80^{mm}. An individual variation of only 1^{mm} in ten specimens is certainly extraordinarily small.

Measurements.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Ant. ext. toe without claw.	Remarks.
U. S. Nat., 120560.	Henson, 30.	♂ ad.	Hakodate, Yezo.	May 11, 1886	80	65	15	20	17	Pale.
U. S. Nat., 120561.	Henson, 24.	♀ ad.	do.	May 11, 1886	80	65	14	20	16	Do.
U. S. Nat., 120562.	Henson, 106.	♀ ad.	do.	May 9, 1884	79	63	13	20	....	Dark.
U. S. Nat., 110208.	Owston, 2895	♀ ad.	Hondo.	.....	79	65	....	20	....	Pale.
U. S. Nat., 110483.	Petersen, 13.	♂ ad.	Urakami, Kiusiu.	Jan. 7, 1886	80	64	13	19	17	Dark.

Yungipicus kizuki seebohmi (HARGITT). (170½)

♀ ad.; Henson No. 186; Hakodate, September 10, 1884.

In my "review" of the Japanese Woodpeckers (Proc. U. S. Nat. Mus., IX, 1886, pp. 120–123) I stated that I had found that the Hondo breeding birds of this species agree completely with typical *Y. kizuki* from Nagasaki, and that only my birds from Yezo were properly referable to *Y. seebohmi*. This was quite opposed to the view of the original describer, who referred all his specimens from the Middle Island to the northern form. Since the publication of my paper Mr. Seebohm has taken the question up again (Ibis, 1887, p. 178), remarking as follows: "In a series of sixteen examples in Mr. Hargitt's collection and my own, those from the North Island of Japan are indistinguishable from those from the Middle Island, whilst those from the Southern Island are conspicuously darker. On the other hand, Dr. Stejneger (Proc. U. S. Nat. Mus., 1886, p. 121) regards a series, apparently of nine skins, from the Middle and Southern Islands as practically the same, while those from the North Island are treated as specifically distinct. It is, of course, possible that Dr. Stejneger is right, and all our skins from the Middle Island are those of winter migrants from Yesso."

Since then I have had the opportunity of examining additional specimens from all three islands, so that the series now before me comprises fourteen skins, all sexes and all but one properly dated. I am therefore in the position to throw more light upon the question.

Mr. Seebohm in the article alluded to characterizes three races of *Y. kizuki*. The form from Liukiu which he calls *Y. nigrescens* is distinguished by having "only four very small white spots on the outer webs of each of the three longest primaries" (*loc. cit.*); in *Y. kizuki* proper these "primaries have five small white spots on each;" while in *Y. seebohmi* "the white spots * * * are larger and are six in number."

The result of an examination of my material may be tabulated as follows:

Locality.	Museum and number.	Number of spots on three longest primaries.			Length of largest spot.
		Third primary.	Fourth primary.	Fifth primary.	
					mm.
North Island (Yezo)	U. S. Nat., 96004	5	6	6	6
	U. S. Nat., 96005	6	6	6	6
	U. S. Nat., 96003	5	6	6	6
	U. S. Nat., 120559	6	6	6	5
Middle Island (Hondo)	U. S. Nat., 91333	5	6	6	6
	U. S. Nat., 91427	5	6	6	6
	U. S. Nat., 91334	5	6	6	4
	U. S. Nat., 91426	5	5	6	5
	U. S. Nat., 109398	5	6	6	5
	U. S. Nat., 109399	5	6	6	4
	U. S. Nat., 88705	5	5	6	4
	U. S. Nat., 111659	5	5	5	4
South Island (Kiusiu)	U. S. Nat., 96002	5	5	5	4
	Petersen, 49	4	5	5	4

It will be seen that there is a regular gradation from north to south, and that the number of spots, or their size, gives no absolute reliable

character by which to separate these subspecies. And, as in the case of the wing spots, so also with the other characters distinguishing *Y. seebohmi* from *Y. kizuki* proper; they intergrade; they are only to be designated by trinominals! Many specimens can only be referred to their proper subspecies by the totality of their characters, and these can only be properly appreciated by placing series of both forms together, carefully comparing them. Specimens from Yezo and Kiusiu are easily distinguishable, and look quite different. Those from the eastern side of the Middle Island (the last four species of the Hondo series in the above table) agree very closely with the typical *Y. kizuki* from the south. But the remaining four of the same series come from the high mountain chain near the western shore of the Middle Island (Tate-Yama), and, as already indicated in my former paper, these are somewhat intermediate, though by a careful comparison with Yezo birds they are found to differ sufficiently from them in the direction of the southern form to be referable to the latter. What the birds of the northern portion of the Middle Island are like nobody knows, but it would not be surprising if those inhabiting the high mountain districts of this portion of the island were indistinguishable from the Yezo birds. In winter they would naturally come down into the lower districts, where only the true *Y. kizuki* breeds, and it would not be necessary to presume a crossing of the Tsugaru Strait in order to explain the presence of typical *Y. seebohmi* in Hondo. The instance of this bird shows plainly how necessary it is to have every portion of the islands thoroughly explored and the specimens from all parts of the Empire most carefully compared by competent investigators.

Mr. Seebohm also says that the bird in the "Central and North Island" is larger. From the tables of dimensions below, it will be seen that the South Island birds are not appreciably smaller than those from the Central Island, and that although one of the smallest specimens is from Tate-Yama the others from this locality are quite as large as the Yezo birds.

But whatever be the opinions as to the occurrence of *Y. sebohmi* in Hondo, this name should be abandoned by those ornithologists who require "hard and fast lines" between their "species."

Measurements of Yungipicus kizuki seebohmi.

U. S. Nat. Mus. No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Ext. ant. toe without claw.
120559	Henson, 186...	♀ ad	Hakodate, Yezo	Sept. 10, 1884	85	48	13	15	10
96004	Blak., 3213....	(♂)ad	Sapporo, Yezo	Oct. 26, 1882	85	50	13	15	10
96005	Blak., 3214....	(♂)ad	....do	....do	83	....	13	15	10
96003	Blak., 2766....	(♀)ad	....do	Nov. 9, 1881	88	52	13	16	11

Measurements of Yungipicus kizuki.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Ext. ant. toe without claw.
U. S. Nat., 91333	Jouy, 698	♂ ad.	Tate-Yama, Hondo	Oct. 17, 1882	80	47	13	15	10
U. S. Nat., 91427	Jouy, 822½	♂ ad.	do	Nov. 30, 1882	85	....	13	15	10
U. S. Nat., 91334	Jouy, 780	♀ ad.	do	Nov. 25, 1882	87	53	14	15	10
U. S. Nat., 91426	Jouy, 801	♀ ad.	do	Nov. 20, 1882	90	52	14	15	10
U. S. Nat., 109398	Namiye	♂ ad.	Subashi, Hondo	Nov. 22, 1884	82	48	12	....	10
U. S. Nat., 109399	do	♀ ad.	do	do	82	48	....	....	.....
U. S. Nat., 88705	Jouy, 314	♂ ad.	Fuji-Yama, Hondo	June 28, 1882	82	45	14	16	10
U. S. Nat., 11165	Namiye, 15	♀ ad.	Miyakeshima, Idzu	May 3, 1887	83	46	14	15	10.5
U. S. Nat., 96002	Ringer	♀ ad.	Nagasaki, Kiusiu	.....	82	46	12	15	10
Christiania, Norw	Petersen, 49	♀ ad.	Tokitsu, Kiusiu	Apr. 19, 1886	80	46	13	14	10

Dryobates subcirris STEJN. (169)

♂ ad., U. S. Nat. Mus., No. 120557; Henson No. 212; Hakodate, Oct. 30, 1884. ♀ ad., No. 120558; Henson No. 213; Hakodate, Nov. 10, 1884.

These birds are typical *D. subcirris* both in size and color, and conform in every detail to the diagnosis which I gave six years ago (Proc. U. S. Nat. Mus., IX, 1886, p. 113). The under side, lower back and greater upper wing-coverts are strongly suffused with buff, and the rump is black.

The question as to the occurrence of true *D. leucotos* in Yezo is still an open one.

Dryobates japonicus (SEEB.). (167)

In Henson's collection there are two specimens undoubtedly referable to this species, though the under surface is rather dark buffy, but the white shoulder patch is comparatively large. One of them, a bird in male plumage (U. S. Nat. Mus. No. 120555, Henson No. 200), collected at Hakodate, November 10, 1884, is molting the first two primaries. The other (No. 120556, Henson No. 167), a female, from the same locality, September 11, 1884, is a comparatively young bird, as testified by two red feathers on the crown, and by the large size of the first (tenth) primary, which measures 35^{mm} in length.

Since writing my "review" of the Japanese Woodpeckers, I have received quite a number of additional specimens, but as they are all winter birds and none from farther south than Tokio, they throw but little light on the question of the occurrence and validity of the so-called *D. gouldii* GRAY from Japan.

It still seems as if the birds from the eastern and southern central portion of Hondo (Tokaido and southern Tosando) have less white* on

* In reply to a footnote by Mr. Hargitt (Cat. B. Br. Mus., XVIII, p. 219), in which he says that I have "stated that in the Main Island of Japan a species is found which has black scapulars and the underparts uniform," I may remark that in the paper quoted (Pr. U. S. Nat. Mus., 1886, Review of the Japanese Woodpeckers) I gave the characters of the supposed species as "Under surface *brownish;* scapulars *mostly* black." It is but just to an author to quote him correctly.

the scapulars than the Yezo and western Hondo specimens, and that their under surface is more deeply colored, but the Tate-Yama birds are intermediate to such an extent that I am now inclined to think that the percentage of distinguishable birds will not be found sufficiently large to warrant the separation of the typical *D. japonicus* and the "so-called *D. gouldii* GRAY." Hargitt has proven conclusively that the true *D. gouldii* MALH. is not a Japanese bird, a thing I hardly doubted myself, but he has failed to show what the bird from Japan in the British Museum is, which Gray called *D. gouldii!* Should it ever be found necessary to designate this bird by a separate name, it will have to be rebaptized, of course.

Picus canus jessoensis STEJN. (172)

Henson's two specimens (U. S. Nat. Mus., No. 120553; Henson, No. 214; [♂] ad., Hakodate, November 13, 1884; and No. 120554; Henson, No. 215; [♀] ad., *ibid.*, November 2, 1884) agree in every particular with the specimen upon which I originally based the present subspecies. They are strongly tinged with green on the head, and hind neck; their entire coloration is lighter and brighter than in north and central European specimens before me; and the black stripes on the occiputs of the males are large and better defined.

Mr. Edward Hargitt in a recent revision of the genus *Gecinus* (Ibis, 1888, pp. 1–42), drawn up in the thorough and excellent manner of this gentleman, takes some pain to show that the present subspecies can not be distinguished from true *P. canus* because (1) his two Japanese female specimens are indistinguishable from specimens from the Vosges, France, and (2) because another Yezo female is gray, like my *P. canus perpallidus*, from the opposite coast of the Asiatic mainland. But it seems to me that this way of reasoning is very much the same as if he were going to prove that *Egithalos trivirgatus* belongs to *Æ. caudatus* proper if it should be found not to differ from *Æ. europæus* (= *roseus*, *vagans*, etc.). In the first place, I would remark that the green color on the head is much more pronounced in the male Japanese birds, and that the difference between these and the European ones which I have seen is greater than in the females. In the second place, I regard the dark Norwegian birds as the types of the name *P. canus;* and as the Japanese ones to my mind are quite sufficiently different to form a subspecies, it makes but little difference so far as *their* nomenclature is concerned whether the French birds are identical with them or not, a proposition which I can neither deny nor affirm, as I have seen none of the latter. Nor have I any reason to doubt that the differences which I pointed out between the Japanese and the central European (German) examples hold good, which I have designated as *P. canus viridi-canus* (M. & W.). Mr. Hargitt has treated but lightly the question whether there exist any races or subspecies of the Gray-headed Green Woodpecker in Europe or not. He only says (*loc. cit.*, p. 20): "It seems to me

that if every slight variation of color necessitates the creation of subspecies, then there would be no limit to such in both *Gecinus viridis* and *G. canus*." If the subspecies really exist, we should recognize them, and it would facilitate our researches if we name them, but whether the number of them be great or small is only a secondary matter. Many ornithologists would willingly recognize two or even three subspecies by names, but they would be scared were it found that a species had split up into a dozen subspecies, or more. Their ruling principle is like that of Mr. Seebohm, who regards a genus as "highly objectionable" because only containing one or two species, though the result is quite different. Mr. Hargitt, moreover, seems to require that it shall always be possible to "draw a line" between the forms which he honors with a name (see *loc. cit.*, p. 14), but from the nomenclature which I adopted in describing the present subspecies under the heading of a trinominal he might have known that I did not claim that any "line" can be drawn. It is the essential difference between binominals and trinominals that a line can be drawn between the forms designated by binominals, but not between those for which it has been found necessary to apply three names.

Nor do I think that a very gray female collected at Sapporo in May proves anything either in regard to the status of *P. canus jessoensis* or to that of *P. canus perpallidus*. Perhaps it may belong to the latter; it would not be surprising; but perhaps it is only a faded and abraded specimen of the typical Yezo bird. However, even if none of these suppositions should hold, it is now well understood by American trinominalists, at least, that isolated cases of this kind do not affect the general status of the subspecies. In fact, in order to justify the use of a trinominal such cases are required.

Dryocopus martius LIN. (171)

A fine pair of this woodpecker is in Henson's collection, the first Japanese specimens I have seen. They are of a very intense black, and the bill is somewhat larger than in a European specimen before me.

U. S. Nat. Mus. No. 120551 ♂ ad., Henson, No. 216; Hakodate, December 2, 1884. U. S. Nat. Mus. No. 120552 ♀ ad., Henson, No. 251; *ibid.*, December, 15, 1884.

Otocoris alpestris (LIN.). (267)

U. S. Nat. Mus. No. 120550 ♂ ad., Henson, No. 1972; southeastern shore of Volcano Bay, Yezo, February 12, 1887.

The Common Horned Lark, or Shore Lark, has only been admitted into the Japanese avifauna with a query on the strength of a Japanese drawing so identified by the authors of Fauna Japonica (Aves, p. 138). Mr. Henson, therefore, has made a real addition to the fauna, since his specimen is the first, and as yet the only example, of this species from Japan, which has come into the hands of ornithologists. It belongs to the normal form, which is quite alike in both hemispheres.

A somewhat full description of this specimen may prove useful and interesting to Japanese ornithologists.

Forehead, supercilary stripe, a crescent across the middle of the ear-coverts, upper half of sides of neck, chin, and throat, delicate straw-yellow, the forehead, chin, and throat brighter, nearly Naples-yellow; upper portion of forehead spotted with black; fore part of crown and a line above the superciliary stripe black, forming, with the latter, a somewhat pointed horizontal feather tuft above the ears; nasal feathers, lores, anterior portion of auriculars, and malar region, black; jugulum similarly colored, forming a large black crescent on the foreneck, not connected with the black cheek patch; auriculars apically drab-gray, forming a well-marked crescent which posteriorly circumscribes the auricular region; posterior half of crown and occiput vinaceous drab, each feather obscurely striped with cinnamon-rufous; hindneck, as well as lower portion of sides of neck, pinkish vinaceous cinnamon, obscurely striped with dull cinnamon-rufous; back grayish wood-brown, more or less distinctly streaked with dusky brown; rump and some of upper tail-coverts strongly suffused with vinaceous cinnamon; under side of body from breast backwards white, flanks suffused with vinaceous cinnamon and streaked with dusky; wings above like the back, outer lesser and median coverts more or less vinaceous cinnamon medially striped with cinnamon-rufous and margined at the tip with whitish; greater wing-coverts, as well as most of the quills, similarly margined in the apical half; under wing-coverts white, the outer ones with gray or dusky centers; middle pair of tail-feathers and longest upper coverts like the back, outer pair blackish brown with the outer webb whitish in the apical half, next pair with a corresponding very narrow white edge, otherwise like the rest of the rectrices, uniform brownish black. Bill pale, horny plumbeous; feet blackish brown.

First (ninth) primary scarcely longer than third, but somewhat shorter than second, these three forming the tip of the wing; second, third, and fourth distinctly sinuated in outer web.

Wing, 110^{mm}; tail-feathers, 69^{mm}; exposed culmen, 10.5^{mm}; tarsus, 22^{mm}; middle toe, with claw, 17^{mm}.

Alauda japonica Temm. and Schl. (266)

U. S. Nat. Mus. No. 120548 ♂ ad., Henson No. 149; Hakodate, May 30, 1885; U. S. Nat. Mus. No. 120549 ♀ ad., Henson No. 150; Hakodate, April 3, 1884.

Mr. Henson's birds agree perfectly with numerous others from Yezo and Hondo. This is apparently the only lark breeding in Japan proper (excluding the Kurils), and from the description and the figure in Fauna Japonica (Aves, p. 87, pl. xlvii) it is to this smaller form that Temminck and Schlegel gave the name *Alauda japonica*, and not to the large one, asMr. Seebohm suggests (Ibis, 1884, p. 41); for not only do their measurements agree (wing 3 inches 9 lines, Pied du Roi= 101^{mm}, slightly less than the average male as given in the table below),

but in the plate the peculiar shortness of the tip of the wing is rendered very exactly.

In 1885 (Orn. Expl. Kamtsch., p. 236) I gave the measurements, including averages, of six Japanese specimens. They are included in the following table, and it is very interesting and gratifying to observe how close the averages of the two series run, as the results indicate that their figures are worthy of confidence.

Blakiston (Chrysanth., 1883, p. 35) informs us that the larks do not winter in Yezo. The present species passes the cold season in Hondo.

Measurements.

U. S. Nat. Mus. No.	Collector and number.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.	Total length.
120548	Henson, 149	♂ ad.	Hakodate, Yezo	May 30, 1885	102	66	12	25	20	....
120549	Henson, 150	♀ ad.	do	Apr. 3, 1884	*99	*65	11	25	19	....
96303	Blak., 1168	♂ ad.	do	Apr. 1, 1873	101	64	12	25	20	178
96305	Blak., 2097	♂ ad.	do	Oct. 1, 1876	100	66	11.5	25	22	171
91551	Blak., 2938	♂ ad.	Sapporo, Yezo	June 23, 1882	104	66	12	....	....	....
96312	Blak., 2939	♂ ad.	do	do	*101	67	12.5	25	20	....
91550	Blak., 2984	♂ ad.	Yubutz, Yezo	Sept. 15, 1882	99	64	12	....	....	....
96316	Blak., 2989	♂ ad.	do	do	(†)	(†)	11	25	21	....
96314	Blak., 2982	♂ ad.	Tomakomai, Yezo	Sept. 16, 1882	102	69	11	24	20	....
96309	Blak., 2844	♂ ad.	Sarubuto, Yezo	May 24, 1884	101	64	12	25	21	....
96306	Pryer, Pl., 2184	♂ ad.	Tokio, Hondo	Mar. 27, 1877	101	64	11	24	20	....
109389	Namiye	♂ ad.	do	Mar. 15, 1883	104	64	12	....	....	....
91464	Jouy, 911	♂ ad.	Yokohama, Hondo	Jan. 3, 1883	106	63	11	....	....	....
96321	Jouy	♂ ad.	do	Jan. ———	100	65	11.5	24	21	....
91465	Jouy, 912	♀ ad.	do	Jan. 3, 1883	92	58	13	....	....	....
91466	Jouy, 913	♀ ad.	do	do	98	65	12	....	....	....
91467	Jouy, 914	♀ ad.	do	do	93	58	11	....	....	....
96322	Jouy	♀ ad.	do	Jan. ———	94	62	11.5	23	20	....
109398	Namiye	♀ ad.	Tokio, Hondo	Mar. 8, 1884	99	63	11	....	....	....
96310	Blak., 2845	♀ ad.	Sarubuto, Yezo	May 24, 1882	94	61	12	24	19	....
96318	Blak., 2990	♀ ad.	Yubutz, Yezo	Sept. 13, 1882	97	60	11	24	20	....
96320	Blak., 2992	♀ ad.	do	Sept. 14, 1882	(†)	(†)	12	25	22	....
96307	Blak., 2369	♀ ad.	Sapporo, Yezo	May 28, 1877	95	59	11.5	24	22	....
96311	Blak., 2903	♀ ad.	do	June 9, 1882	94	61	12	25	19	....
	Average measurements of 13 males				102	65	11.6	24.7	20.4	....
	Average measurements of 11 females‡				95	61	11.6	24.3	20.1	....

* Much worn.
† Molting.
‡ The U. S. National Museum possesses three more adult specimens of *Alauda japonica* (Nos. 96302, 96308, 96319) which, in view of the above series, it is unnecessary to measure, as they are not sexed by the collectors. Three young ones also belong to the Museum, viz: No. 88657, collected by Mr. Jouy, at Fuji, July 22, 1882; No. 96304, Hakodate, June, and No. 96317, Yubutz, September, both collected by Capt. Blakiston.

Alauda blakistoni STEJN. (266½)

U. S. Nat. Mus. Nos. 120546–7, two ad. ♂ ♂, Henson, Nos. 148, 722; Hakodate, November 5, 1885; April 2, 1886.

As contended by Capt. Blakiston long ago, there is no difficulty in keeping separate the two forms of larks which inhabit Japan, for the measurements alone are sufficient to distinguish them, as shown by the appended tables of dimensions.

A. blakistoni is very nearly allied to *A. intermedia* SWINH. of the opposite mainland and to *A. arvensis* LIN. of Europe, being, in fact,

only a subspecies of the latter. These belong to a northern type of migratory habits, characterized by having the tip of the wing much elongated, that is, the first four primaries which form the tip of the wing are lengthened so as to reach farther beyond the others than in the birds of the southern type. This latter is represented in Japan by *A. japonica*, which in turn is only subspecifically distinct from *A. cælivox* SWINH. from China. These forms I believe in the main to be resident birds. The difference in the construction of the wing above alluded to is well pronounced in the Japanese species and may be expressed as follows:

(1) *Alauda blakistoni*, distance of fifth primary from tip of wing greater than middle toe, without claw;

(2) *Alauda japonica*, distance of fifth primary from tip of wing less than middle toe, without claw.

These characters, of course, are only well pronounced in specimens the quills of which are fully grown and not much abraded.

Mr. Seebohm admits (Ibis, 1884, p. 41) the existence in Japan of two races distinguished by their difference in size. The larger one, with "the wing varying in length from 4.9 to 3.9 inches," he says "might be called var. *japonica* by ornithologists anxious to split hairs." This name I consider referable to the smaller form.

Alauda blakistoni was based by me on Kamtchatkan specimens before I had seen any skins from Japan. A comparison of the figures of the table below with those given by me in my Orn. Explor. Kamtsch., p. 235, shows a remarkable uniformity; the averages of wing and tail being identical to the millimeter.

Alauda blakistoni has as yet been reported in Japan only from Yezo and the Kurils. It breeds apparently on the latter, and passes through Yezo only during the migrations, which do not seem to extend to Hondo. As we have no Yezo winter specimens, this form probably winters somewhere on the mainland.

Measurements.

U. S. Nat. Mus. No.	Collector and number.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.	Total length.
120546	Henson, 148	♂ ad.	Hakodate, Yezo	Nov. 5, 1885	124	76	13	26	24	....
120547	Henson, 722	♂ ad.	....do	Apr. 2, 1886	*112	*68	13	27	23	....
96313	Blak., 2981	♂ ad.	Tomakomai, Yezo	Sept. ——	†109	69	12.5	26	22	....
96315	Blak., 2985	♂ ad.	....do	Sept. ——	(†)	(†)	12.5	26	22	....
96298	Blak., 1569	♂ ad.	Nemoro, Yezo	Oct. 6, 1874	115	71	12	26	22	....
96300	Blak., 2770	♂ ad.	Iturup, Kurils	Sept. ——	†116	71	12.5	26	23	196
96301	Blak., 2771	♂ ad.	....do	Sept. ——	†121	74	12	27	24	205
96299	Snow, Blak., 2735.	♂ ad.	"Kuril Islands"	.....	117	74	12	26	22	....
Average measurements of 7 males					116	72	12.6	26	22.9	....

* Much worn. † Partly molting.

Motacilla lugens KITTL. (229½)

It is just as well to state at the outset that this is not the *Motacilla lugens* of Fauna Japonica, which is the next species; or, perhaps, it may be better to give the full synonymy of both species, in order not to be misunderstood.

1784.—*Motacilla alba* PENNANT, in Cook's Voy. Pacif., III, p. 355 (*nec* LIN.).
1826.—*Motacilla albeola* var. PALLAS, Zoogr. Ross. As., I, p. 507.
1833.—*Motacilla lugens* KITTLITZ, Kupfertaf., p. 16, pl. xxi, fig. 1 (*nec* TEMM. & SCHL.)—CASSIN, Perry's Exp. Jap., II, p. 221 (1856).—*Id.*, Proc. Acad. Philada., 1858, p. 193.—SEEBOHM, Ibis, 1878, p. 347 (in part only).—*Id.*, B. Jap. Emp., p. 111 (1890).—STEJNEGER, Orn. Expl. Kamtsch., p. 287 (1885).—SHARPE, Cat. B. Brit. Mus., X, p. 474, pl. iv, figs. 1–4 (1885).
1833.—*Motacilla lugubris* GLOGER, Abänd. Vög., p. 148 (*nec* TEMM., 1820).—TEMM., Man. d'Orn., 2d ed., III, p. 175 (*part*) (1835).—CABANIS, Mus. Hein., I, p. 12 (1850).
1839.—*Motacilla leucoptera* VIGORS, Voy. Blossom, p. 18 (*nec* SELYS, 1856).—ZANDER, Naumannia, 1851, iv, p. 14.
1844.—"*Motacilla albeola* var. *camtschatcæ* PALL.," SCHLEGEL, Rev. Crit., p. 68.
1850.—"*Motacilla albeola* var. *camtschatica* PALL.," Bonaparte, Consp. Av., I, p. 250.
1851.—*Motacilla alba lugens* ZANDER, Naumannia, 1851, iv, p. 13.
1863.—*Motacilla ocularis* SWINHOE, P. Z. S., 1863, p. 275 (*part*).
1863.—*Motacilla japonica* SWINHOE, Ibis, 1869, p. 306,—*Id.*, *ibid.*, 1874, p. 156 (*part*).—WHITELY, Ibis, 1867, p. 198.—BLAKIST. & PRYER, Ibis, 1878, p. 236 (*part*).—*Iid.*, Tr. As. Soc. Jap., VIII, 1880, p. 220 (*part*).
1878.—*Motacilla amurensis* SEEBOHM, Ibis, 1878, p. 345, pl. ix.—*Id.*, *ibid.*, 1883, p. 91.—*Id.*, *ibid.*, 1884, p. 39.—BLAKIST. & PRYER, Tr. As. Soc. Jap., X, 1882, p. 155.—BLAKISTON, Chrysanth., 1882, p. 522.—*Id.*, *ibid.*, 1883, p. 174.—*Id.*, Amend. List B. Jap., p. 53 (1884).
1882.—*Motacilla kamtschatica* STEJNEGER, Naturen, 1882, p. 182.
1882.—*Motacilla camtschatica* TACZANOWSKI, Bull. Soc. Zool. France, 1882, p. 388.
1883.—*Motacilla* ———— ? BLAKISTON, Chrysanth., 1883, p. 31.
1883.—*Motacilla blakistoni* SEEBOHM, Ibis, 1883, p. 91.—*Id.*, *ibid.*, 1884, p. 38.—RIDGWAY, Pr. U. S. Nat. Mus., VI, 1883, p. 147.
——.—*Motacilla mutabilis* BLAKISTON, MSS. and labels.

It is only during the last few years, and due to the late Capt. Blakiston's indefatigable efforts, that the two Japanese species of Wagtails have become thoroughly understood, for not only has the nomenclature been in a most deplorable state of confusion, but the fact that both species occur in the same locality, at certain seasons at least, coupled with the great variation of the plumages, according to age and season, presented some of the most perplexing knots in Japanese ornithology; in order to untie them it was necessary for Capt. Blakiston to bring together about seventy specimens collected at all seasons. In an interesting article in the "Chrysanthemum" (1883, p. 31), and in the "Amended List of the Birds of Japan," pp. 52–55 (1884), he ably disentangled the skein, and recently Mr. R. Bowdler Sharpe (Cat. B. Brit. Mus., X, 1885), has added materially to the clearness of the case by giving the black-eared species a new name, and by systematically describing and illustrating the different plumages of *M. lugens*.

It appears, however, that the differences have not been contrasted in such a way as to enable the field ornithologists to distinguish the two

species in all plumages, for Mr. Henson, who has correctly named nearly all the other species of his large collection, has sent me the entire lot of White Wagtails without an attempt to identify them, simply labeling them "*Motacilla*—?" It may, therefore, not be out of place to give a brief tabular synopsis of the chief differences by which the various plumages are most easily distinguished.

Plumage.	*Motacilla lugens.*	*Motacilla grandis.*
Young in first plumage (June, July, August; plumage easily recognized by the loose and open texture of the contour feathers).	Upper surface "smoke gray" (Ridgw., Nomencl. Col., pl. ii, n. 12); ear-coverts and entire fore-neck white faintly washed with "cream color," each feather narrowly edged at tip with dusky, more broadly on lower jugulum, forming an indistinct dusky collar across the latter; greater upper wing-coverts dark brownish gray broadly margined with white; middle coverts dusky at base, grayish white at tip with a dusky shaft streak.	Upper surface, ear-coverts, and entire fore-neck, uniform dark "drab-gray" (Ridgw., Nomencl. Col., pl. ii, n. 13); greater upper wing-coverts white to the base; middle coverts likewise entirely white.
Young after the first molt (which usually is finished before the middle of October; texture of contour feathers firm; remiges and rectrices not molting).	Upper surface smoke-gray more or less strongly washed with straw-yellow, the males usually more or less black on hind crown; supraloral region, supercilia, ear-coverts, malar region, sides of neck, chin, and throat white tinged with straw-yellow; upper jugulum similar, but feathers subapically margined with blackish, lower jugulum with a black, semilunar collar, each feather apically margined with whitish; through the eyes a dusky line; wings as above.	Upper surface, sides of head, including ear-coverts, sides of neck throat, and jugulum, dead black; feathers on upper surface more or less broadly margined at tip with grayish; forehead, superciliary streak, and chin pure white; wings as above.
Adult bird (*i. e.*, birds ready for propagation) *after the first spring* (no matter what the coloration of the wing), *summer, and winter.*	Cheeks (malar region, suborbital region, auriculars) and sides of neck white. Tarsus shorter, 23^{mm} to 25^{mm}.	Cheeks and sides of neck black. Tarsus longer, 25^{mm} to 27^{mm}.

Notwithstanding the great superficial similarity in the two species, to the close observer they are very different indeed. Their general size is about the same, but the proportions differ materially, *M. grandis* having a longer and at the base comparatvely narrower bill and considerably longer tarsus than *M. lugens*. The changes of plumages, moreover, are radically dissimilar, in fact so much so, that this case ought to be a warning to ornithologists not to be too hasty in concluding that, while he knows the change of plumages is one form to be of a certain nature, that of the nearest allied species is essentially alike. Capt. Blakiston, I think, was the first ornithologist to announce (Chrysanth., Jan. 1883, p. 31), the interesting observation that in *M. grandis* the young birds during the first autumn pass at once into the black plumage, while the young *M. lugens* are gray during the first winter, and that subsequently the former remains black during all seasons, while the latter is black in summer only and gray in winter.

It is quite evident from Capt. Blakiston's manuscript notes, as well as from the labels attached to the specimens in his collection, that he considered the differences in the wing pattern found in the various in-

dividuals of *M. lugens* to be due to successive molts of the quills. Mr. R. Bowdler Sharpe (*loc. cit.*), on the other hand, seems to maintain that the changes between the different patterns of wings take place during the time between the molts. And he too bases his conclusions upon a study of the series in Blakiston's collection. It would therefore seem as if this series were not quite sufficient to settle the question, and so is in fact the case, for, although very complete in autumnal specimens, spring birds are comparatively not so well represented. The large series of the present species, which I myself collected in Kamchatka, on the other hand, contains mostly specimens killed during the month of May (cf. "List of specimens collected," Res. Ornith. Explor. Kamtschatka, p. 291), supplementing Capt. Blakiston's collection to a great degree. I am therefore in the position to throw considerable light on the subject, and hope to be able to settle a part of this vexed question.

Before attempting this, however, a few general remarks in regard to points which must not be lost sight of during the following discussion may not be out of place. It is then to be noted that while the color of the small plumage is changed twice a year, the quills and tail-feathers are only shed once, viz, in autumn. The last (proximal) three secondaries (or "tertiaries") form an exception to this rule, inasmuch as they are molted twice a year. In speaking of the changes which take place at the annual (autumnal) molt of the quills, we do not include any reference to the last three, in order not to create any confusion. I will also mention that I shall designate the three figures of the wing of *M. lugens*, presented by Mr. Sharpe in the tenth volume of the "Catalogue of the Birds in the British Museum," on pp. 475, 476, and 477, as fig. 475, fig. 476, and fig. 477, respectively.

Of *M. lugens* ten specimens in the first plumage are before me, seven belonging to Mr. Henson's collection (Henson's Nos. 28, 29, 31, 40, 41, 42, 65) and three to Capt. Blakiston's (Blak., Nos. 1389, 1390, 1561; U. S. Nat. Mus., Nos. 96206, 96207, 96208), the former collected during August, the latter during September and July; some are marked as male and some as female, but all are essentially alike in regard to the distribution of whitish and brownish gray, agreeing minutely with Sharpe's fig. 475. As this figure does not exhibit the inner webs of the quills, I append a sketch of the secondary next to the longest "tertiary" (pl. XLV, fig. 1). Birds which have finished their molt have exactly the same quill pattern, as testified by twelve specimens collected in September and October (Henson's No. 328; U. S. Nat. Mus., Nos. 96210, 96212, 96220, 96227, 96228, 96229, Blak. coll.; 92689, Stejn. coll., all September birds, and Henson's No. 335; U. S. Nat. Mus., Nos. 96223, 96224, 107107, Blak. coll., October). I have, furthermore, four November specimens (Henson's No. 735, Hakodate; U. S. Nat. Mus., No. 96214, Yokohama, Owston coll.; 96213, Nagasaki, Ringer coll.; Petersen's No. 74, Nagasaki) which differ in no particular from the figures quoted above. From December and January I have no examples, but from the fact that a

male killed in February (U. S. Nat. Mus. No. 96218, Nagasaki, Ringer coll.) and two males in March (91531, 91559, Tokio, Jouy coll.*) offer no differences from the early winter birds it is safe to conclude that specimens from the intervening months are equally alike. Early April specimens are wanting; however, a bird obtained by Mr. Grebnitzki on Bering Island, April 30 (U. S. Nat. Mus. No. 106609)† and one by Blakiston in Yezo during May (U. S. Nat. Mus., No. 96192), as well as ten others from Kamtchatka and Bering Island, collected during the latter month (Nos. 92682, 88985, 88986, 92683, 92686, 92681, 96606, 96607, and Stejneger Nos. 1035, 2031), show no trace of change in the quill pattern; at least not in the direction supposed by Mr. Sharpe, for the northern birds appear to have the dark color on the outer web of the last secondary (the one figured as above) more extended towards the base. This series is concluded by two birds in full breeding plumage, one (♂) shot by myself in Petropaulski, Kamtchatka, June 27, 1882 (U. S. Nat. Mus., No. 89146), the other (♀) collected by Blakiston at Cape Blanco, Yezo, June 23, 1873 (No. 96194), the latter in a very abraded plumage, both of which in every essential particular have the quills colored in the same manner as the birds in the first plumage killed the year previous in July, August, and September.

We have thus examined a series of forty-three specimens, illustrating the pattern of the quills, from the birds leaving the nest until they have become a year old and are rearing their own young. This material proves most conclusively that the quills undergo no change whatsoever in regard to the relative distribution of white and dusky (except, of course, the gradual wearing away of the whitish edges during the second summer). It is also to be noted, that in this enormous series the individual variation is but very slight.‡

The yearly molt of the quills does not take place until about two months later than the latest specimen enumerated above, and from these months I have no specimen to show. I should therefore have expressed myself much more guardedly in regard to a possible change in the coloration of the quills during the last period before the molt, had it not been that our collection contains a most interesting specimen which,

*These two specimens are molting their "tertiaries," and the new black feathers on the back make their appearance; throat already black in No. 91559. I make this statement well aware of the fact that Dr. H. Gätke (Journ. of Orn., 1854, p. 323) flatly denies a prenuptial molt in the British White Wagtail. He says: "Von beiden Arten [*Motacilla lugubris* (*yarrellii*) and *Anthus littoralis*] habe ich Hunderte von Exemplaren in allen Stufen des Ueberganges vom Winter- zum Sommerkleide in Händen gehabt, *nie* aber *neu hervorkeimende*, halb- oder weiter ausgewachsene Federn finden können." However this may be in the European bird, the fact remains that in the specimens referred to, most of the black feathers on the back are still in their sheaths.

†From this time on all the specimens are in full summer plumage; throat black; males with back black, females gray.

‡The greater amount of dusky on the proximal secondaries in the Kamchatkan spring specimens is possibly a peculiarity of the breeding birds of that country.

in connection with the above series, most satisfactorily completes the proof and makes it incontrovertible.

This specimen, a female, was collected by Capt. Blakiston at Yubutz, Yezo, September 15, 1882 (U. S. Nat. Mus., No. 96211; Blak., No. 2958), and is in full molt all over. The black feathers on top of the head are giving way to gray ones tinged with yellow; the anterior portion of the back has already assumed the latter color; new white feathers delicately suffused with straw-yellow appear on the throat; several new black marginal (smaller) upper wing-coverts have taken the place of the gray ones; the tail feathers also are molting, and in the left wing the longest "tertiary" has fallen out. Most interesting is the molt of the other quills, inasmuch as all the primaries and all but two of the secondaries are new and still partly in the sheaths; the two secondaries left from the old plumage are the two ones next to the "tertiaries," quite brown and faded and with the whitish margins nearly entirely worn off, but the extent of terminal dusky and basal white is exactly as in the July bird just out of the nest, which we have already figured (pl. XLV, fig. 1). In a day or two these feathers would have fallen out, and we have thus proof that the first quill pattern remains absolutely unchanged until the molt in the second autumn. This demonstrated, we will now take a look at the new quills in this bird. Only the six inner primaries are nearly fully grown, and of the secondaries only the three next to the primaries are so far grown that this pattern can be made out. In a general way they do not differ greatly from the wing pattern of the first plumage, except that the dusky portion is blacker and less extensive, while the light bases and margins have increased in extent and whiteness; the black in the outer web of the primaries descends along the shafts nearly to the base. So far as I can make out, this pattern is the one which Mr. Sharpe represents in fig. 476. In order to give an illustration of the secondary next to the longest "tertiary" for comparison with my previous figure of the corresponding quill in the young bird, I select another specimen, with which the molting bird alluded to agrees in every respect as far as the quills already grown out are concerned. This specimen is U. S. Mus. No. 96205 (♀, Tomakoma, Yezo, September 17, 1882, Blak. coll., No. 2959), shot only two days later than the above female, but probably of an earlier brood, inasmuch as the entire molt is finished. Pl. XLV, fig. 2, gives a fair idea of the distribution of black and white on the inner secondaries in this stage of plumage, while fig. 3 illustrates the same on the fifth primary. Quite a series of specimens agree closely with this type, which we regard as representative of the birds in the second winter and third summer, viz: U. S. Nat. Mus., Nos. 96226 (Yezo, September), 107016 (Nagasaki, December 25), and 96195 (Yezo, April); Henson, No. 138 (Yezo, April 19); U. S. Nat Mus., Nos. 96196 (Yezo, May 16), 107014 (Yezo, June 22); 96212 (Yokohama), and 107108 (Nagasaki), the latter two, however, without date and sex on the collector's labels. All these

are designated as females by the collectors, except the last two, of which the Yokohama specimen is undoubtedly a female, while the Nagasaki bird may possibly be a male. As the series covers the time from the autumnal molt until the middle of June next year, and as there is no perceptible increase of the white color to be observed, it seems fair to conclude that the quill pattern of the females of the second year remains nearly unchanged until the molt in the third autumn; consequently that the black does not "gradually disappear," at least not in the females, during the second year.

We headed the foregoing series with a September female just molting and another one having just finished the molt of her second autumn. No. 96209 (U. S. Nat. Mus.) is also a September male, collected by Blakiston at Yubutz, Yezo, September 13, 1882 (Blak., No. 2957), which has just passed the molt, traces of the "sheaths" still adhering to the basis of several of the quills, while the first primary and the innermost secondary is not yet fully grown out. That it is not a bird of the year is plain from the fact that some of the feathers on the back are blackish, while nearly all the lesser wing coverts are black; that it is not much more than a year old, I think, will be plain from the pattern of the quills, the secondary and primary corresponding to those of the female already figured, being figs. 4 and 5, pl. xlv. It will be seen by a comparison with figs. 2 and 3 that the difference in male and female in the quill pattern during this stage is slight, although the latter is evidently "more backward," as Mr. Sharpe remarks. Like the female, this specimen has the white of the head and the back suffused with yellowish. Another male in precisely the same stage of molt was shot by Capt. Blakiston on the following day (U. S. Nat. Mus., No. 107015; Yubutz, Yezo, September 14, 1882; Blak., No. 2955), has the wing pattern essentially similar, the fifth primary having only a little more white in the inner web along the shaft, but on the proximal secondary the black is reduced to a slight dusky trace in both webs. A third male, shot by the same gentleman on the last day of the same month (U. S. Nat. Mus., No. 96225; Blak., No. 3031), is absolutely similar, but there is hardly a trace of dusky left on the proximal secondary. In all three the black on the outer webs of the outer primaries extends considerably towards the base, but is especially pronounced and extensive in the last-mentioned specimen. These three examples being shot nearly at the same time show plainly the range of individual variation in regard to the quill pattern, and demonstrate the necessity of dispensing with the theory of a gradual change taking place during the following winter, a conclusion furthermore strengthened by an inspection of the following specimens: U. S. Nat. Mus., No. 96222 (♂, Yezo, Oct. 10, 1882; Blak., No. 3101), very much like the bird figured (figs. 4 and 5), but the outer web of the proximal secondary nearly entirely white, and black on outer webs of outer primaries very heavy; No. 96201 (♂, Yokohama, Nov. 20, 1882), nearly identical with No. 96225, but black on

outer webs of outer primaries more like No. 96209; No. 96202 (♂, Nagasaki, Dec. 25, 1882), quite similar. Henson's No. 157 (♂, Hakodate, April 16, 1884) and Stejneger's No. 2035 (♂, Petropaulski, May 17, 1883), both in full summer plumage, are also identical with the foregoing specimens. Finally I have to mention a male which I shot at Petropaulski, Kamtchatka, on May 17, 1883 (U. S. Nat. Mus., No. 92685); it is in full summer plumage, black-backed, and I dissected it myself; it is also the latest as to date in the series of males, yet it has more black on the quills than any of the foregoing ones, the proximal secondary and the fifth primary being in fact absolutely identical with those of the female, figs. 2 and 3.

So far our material has been ample and our conclusions, I think, safe. There remain only seven specimens, the quill pattern of six of which differ considerably from that of the foregoing series (figs. 2–5). Although taken from the most extreme specimen, pl. xlv, fig. 6 represents very well the fifth primary of this group, as compared with figs. 3 and 5, while the proximal secondary is pure white, or nearly so (all or most of the secondaries being in fact similar). The first bird of this series to attract our attention is No. 96203, collected by Mr. Ringer at Nagasaki, December, 1879, and by him designated as a female. Nearly all the secondaries are pure white; the black on the outer web of the four outer primaries does not extend further down than on the inner web, and the fifth primary is colored very much like the one figured (fig. 6). Should the determination of the sex be correct, I should think it most probable that this pattern had been assumed after the molt in the third autumn, since the difference seems to be too great to be only an individual variation of quill pattern (fig. 3). A September male (Yezo, Blakiston, No. 2956; U. S. Nat. Mus., No. 96200) and a summer bird, male, collected in the Kurils by Mr. Snow (U. S. Nat. Mus., No. 96198), on the other hand, are quite similar, having the black apical patch on the fifth primary somewhat larger than in fig. 6, the latter being collected at Hakodate in March by Capt. Blakiston (U. S. Nat. Mus., No. 96197). It will be observed that the difference between these males and the lighter ones already referred to the type represented by figs. 4 and 5 is not so great as to preclude the possibility of their being only individual variations of the same stage of plumage, and it must be admitted that the three last specimens of our collection, which we have not yet mentioned, seem to point in this direction. The first of these is a ♂ collected by Mr. Henson at Hakodate, May 16, 1883 (U. S. Nat. Mus., No. 96199), the left wing of which is quite normal, with a fifth primary like fig. 6, but with some dusky marks on the proximal secondary. In the right wing, however, fourth and fifth primaries, although apparently fully grown, are considerably shorter than normally, and the greater pureness of the white color at once indicates that they are of more recent origin than the rest, in other words, that they have recently grown out in the place of the old ones which had been lost

accidentally; of these new feathers the fifth primary has quite as much black as fig. 5, while the fourth one in the inner shows even more than the average *female* after the molt in the second autumn, though the outer web is pure white, except at the tip, a feature only visible in a few of the most extreme specimens. The other bird is an unsexed specimen in the middle of the autumnal molt (Henson's No. 39, Hakodate, Aug. 14, 1882) contour feathers as well as remiges and rectrices being shed; in the wing, which even in the old plumage belongs to the extreme white type, the five proximal primaries are fully grown; the third and fourth are still small, while the two outer ones as well as all the secondaries belong to the old plumage. So much can be said from this specimen that the new feathers have just as much black as the old ones, and that in this bird, at least, the new molt would not have brought on an increased amount of white. To this may be successfully replied, however, that this bird had already at some previous molt obtained its maximum of white, and that it consequently does not prove that at the molt in the third autumn the quill pattern of figs. 2–5 is not exchanged for that of the extreme white type. Nor does the last specimen before me, a female which I collected in Kamtchatka, May 24, 1883 (U. S. Nat. Mus., No. 92688), prove much either way. Although being surely a female it has a fifth primary like fig. 5 (♂) and a proximal secondary nearly white. It is consequently whiter in the quill pattern than any female in the series, the sex of which is ascertained beyond a doubt. As I have pointed out above, the Kamtchatkan birds seem to have a somewhat *darker* wing than the birds breeding in the south. Is the present specimen, therefore, a bird in the fourth year, or is the unusual amount of white simply due to individual variation?

After having thus examined a series of about seventy examples, we are reluctantly forced to admit that still more examples are needed in order to get at the bottom of the question. About twenty more white-winged *M. lugens*, collected in the north of Japan between the beginning of August and the middle of September, in the different stages of molt, and accurately sexed by dissection, will be necessary to end the dispute. Will our friends in that country help us to complete the series and end the dispute? But no more young birds with "brown" wings need be slaughtered.

Mr. Henson's thirteen specimens having been mentioned during the above already too lengthy discussion, I consider it unnecessary to refer to them more particularly.

Motacilla grandis Sharpe. (229)

As with the foregoing, it will be most instructive to begin with the synonymy as follows:

1835.—*Motacilla lugubris* Temminck, Man. d'Orn., 2d ed., III, pp. li, 175 (*part., nec* 1820).

1847.—*Motacilla lugens* TEMMINCK & SCHLEGEL, Fauna Japon., Aves, p. 60, pl. XXV (*nec* KITTLITZ, 1833).—? BLAKISTON, Ibis, 1862, p. 319.—*Id.*, Chrysanth., 1882, p. 522.—*Id., ibid.*, 1883, p. 31.—*Id., ibid.*, 1883, Feb., p. ——. *Id., ibid.*, 1883, p. 174.—SEEBOHM, Ibis, 1879, p. 34.—BLAKIST. & PRYER, Tr. As. Soc. Jap., X, 1882, p. 155.—JOUY, Pr. U. S. Nat. Mus., VI, 1883, p. 290.

1866.—*Motacilla japonica* TRISTRAM, Ibis, 1866, p. 291 (*nec* SWINH., 1863).—SWINHOE, Ibis, 1874, p. 156 (*part.*).—BLAKIST. & PRYER, Ibis, 1878, p. 236 (*part.*).—*Id.*, Tr. As. Soc. Jap., VIII, 1880, p. 220 (*part.*).—BLAKIST., Amend. List B. Jap., p. 52 (1884).—STEJNEGER, Orn. Expl. Kamtsch., p. 289 (1885). SEEBOHM, B. Jap. Emp., p. 112 (1890).

1885.—*Motacilla grandis* SHARPE, Cat. B. Br. Mus., X, p. 492.
Motacilla immutabilis BLAKISTON, MSS. and labels.

Mr. Sharpe was undoubtedly correct in giving this species a new name, since Swinhoe (who afterwards, however, confounded the two species) bestowed the name *M. japonica* upon "the black-backed race [of *M. ocularis*] * * * , peculiar to the Japanese islands" (Ibis, 1863, p. 309, footnote), which, of course, is the true *M. lugens*.

It has already been remarked under the head of *M. lugens* that the changes of plumage in the two Japanese species of Wagtails are quite different, and this statement does not apply to the contour feathers alone, but to the quills as well, for it is evident that *M. grandis* does not pass through the "brown" stage of *M. lugens*, as the young birds upon leaving the nest have the white and black of the quills as strongly contrasted as the adults, while the white color in this stage of the wings, which lasts until the molt in the autumn of the next year, is somewhat more extended than in the corresponding stage of *M. lugens*. However, all the quills are marked with dusky, except occasionally one or two of the inner secondaries. The male, as a rule, seems to be a trifle more white than the female. The series of thirteen specimens before me seems to prove that no change takes place in the quills between the molts. After the autumnal molt the next year all the secondaries become pure white, and the black on the inner primaries is greatly reduced, so that these parts now exactly resemble the corresponding quills in the most extremely white *M. lugens*. On the outer primaries the black is also somewhat restricted, but not so much so as in *M. lugens;* the black tips are much longer, and the black on the first primary reaches nearly always to the base, thus presenting a very marked difference from the adult *M. lugens* in the corresponding plumage.

Of this species Mr. Henson's collection only contains a single specimen (No. 821), a female, in the first year, collected at Hakodate, December 5, 1885; U. S. Nat. Mus. No. 120527.

Motacilla melanope PALL. (230)

♂, No. 139, Hakodate, September 17, 1884; ♀, No. 163, *ibid.*, September 10, 1884. U. S. Nat. Mus. No. 120541–2.

Anthus maculatus Hodgs. (225)

Two ♂ ♂, Nos. 698, 154; Hakodate, November 25 and 27, 1883; ♀, No. 28, *ibid.*, July 19, 1886. U. S. Nat. Mus. Nos. 120544, 120543, 120545.

Turdus cardis Temm. (260)

Four specimens, of which one just out of the nest, all in the olive plumage. Two of them are marked ♂, but this must be a mistake, for, as I shall show, the sexual difference in coloration is very pronounced in all plumages.

When Seebohm treated of the Thrushes in the fifth volume of the "Catalogue of the Birds in the British Museum" (1881), the young in the first plumage were unknown. Since then nestlings and young ones just out of the nest have been collected by Mr. Jouy and Mr. Henson. I have also a full series of the other plumages, so that a few remarks on the different plumages and their changes may not be out of place.

♂ in *nestling plumage* is of a blackish slate color above with but a very slight suffusion of fulvous, and with very distinct pale buffy shaft streaks; tail and wings similarly colored, though more fulvous towards the outer margins of the feathers; the terminal spots of ochraceous buff on the upper wing-coverts are rather large on the middle row, but nearly obsolete on the larger ones; the dusky spot on the under side are large, and the buffy tinge suffusing the white ground color rather pale (U. S. Nat. Mus., Nos. 88607, 88612).

The *nestling* ♀ differs considerably, being of a dark, dull, tawny olive above, with dusky margins to the tips of the feathers and narrow, buffy shaft streaks more or less pronounced; tail and wings more fulvous than in the male, without any slaty cast, and the ochraceous tip to the greater upper wing-coverts rather larger and well defined; sides, breast, and fore-neck more strongly suffused with ochraceous (U. S. Nat. Mus., No. 88608, and Henson, No. 5).

♂ *jun., after the first autumnal molt* differs very much from the female in corresponding plumage. The entire upper surface is of a dull plumbeous or bluish slate gray, nearly pure on lower back and wing, and but slightly suffused with fulvous on head and interscapulars, but more strongly so on the secondaries, and especially the greater upper wing-coverts which have the tips narrowly margined with pale ochraceous buff; sides of head dusky, with but faint fulvous suffusion; fore-neck and breast very thickly spotted with large blackish, fan-shaped terminal spots, the visible ground color between them being pale plumbeous on the chest and lower neck, whitish on throat and chin, but suffused with ochraceous; rest of under surface pure white, tinged with plumbeous on the flanks and with ochraceous on the sides of the breast, these parts, besides, spotted with blackish like the breast; under wing-coverts ochraceous rufous. (This description is taken from a specimen collected by Mr. P. L. Jouy, in Fusan, Corea, April 26, 1886. Jouy, No. 1585.)

♂ *after the following* (second) *autumnal molt* resembles the above in the color of the back, but the head and face are blackish and the fore-neck and chest are of a uniform dull, brownish slate, only the chin being whitish; secondaries and greater upper wing-coverts are still strongly washed with fulvous, but the ochraceous wash on the under side has disappeared, and the under wing-coverts are slate-gray in the middle, being only broadly margined with ochraceous (U. S. Nat. Mus., No. 96289).

In the *fully adult* ♂ all traces of fulvous disappear; the black of the head, fore-neck, and chest becomes darker and pervades the back, and even the under wing-coverts are blackish (U. S. Nat. Mus., Nos. 88606, 96288).

The *adult* ♀ is olive above; fore neck, chest, and flanks strongly suffused with ochraceous spotted with black; under wing coverts bright ochraceous. *In summer* slightly gray above, *in winter* more fulvous. (Numerous specimens.)

Measurements.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.
U. S. Nat., 120326	Henson, 1235	♀ ad	Hakodate, Yezo	Oct. 6, 1884	110	73	17	30	27
U. S. Nat., 120327	Henson, 1241	(♀) ad	do	do	109	73	18	30	28
U. S. Nat., 120328	Henson, 1233	(♀) ad	do	Oct. 4, 1884	111	72	18	30	29
U. S. Nat., 120329	Henson, 5	(♀) ad	do	July 20, 1883	108	63	18	30	.....
Christiania, N	Petersen, 70	♀ ad	Nagasaki, Kiusiu	Nov. —, 1886	110	71	19	30	28
U. S. Nat., 96288	Ringer, 18	♂ ad	do	Dec. 13, 1876	114	76	19	30	28
U. S. Nat., 88606	Jouy, 495	♂ ad	Fuji, Hondo	July 13, 1882	118	80	19	29	27
U. S. Nat., 88611	Jouy, 454	♀ ad	do	July 8, 1882	111	70	18	29	27
U. S. Nat., 88608	Jouy, 594	♀ juv	do	July 24, 1882	106	62	18	29	.....
U. S. Nat., 88612	Jouy, 526	♂ juv	do	July 16, 1882	85	30	15	28	27
U. S. Nat., 88607	Jouy, 381	♂ juv	do	July 2, 1882	71	18	14	29	26
U. S. Nat., 96289	Blak., 758	♂ ad	Hakodate, Yezo	Oct. 21, 1861	112	76	....	30	28
U. S. Nat., 96287	Blak., 2356	(♀) ad	Sapporo, Yezo	Oct. 12, 1877	111	75	18	29	28

Turdus eunomus TEMM. (264)

A normally colored pair of this species is in Henson's collection: ♂ ad., No. 81; Hakodate, March 15, 1884; ♀, No. 658, same locality and date; U. S. Nat. Mus., Nos. 120330–1. The latter specimen agrees very closely with Naumann's, fig 1, pl. lxviii, Naturg. Vög. Deutschl., Vol. II, and his excellent description of the same specimen on p. 291, which, however, he erroneously refers to *T. naumanni*. Two females collected by Jouy in Tate-Yama, Hondo, October 27, 1882 (U. S. Nat. Mus., Nos. 91311, 91312), agree even better with the figure in question, as they have the spots on the flanks still browner than Henson's bird.

Turdus naumanni TEMM. (261)

A pair of this comparatively rare Thrush in Henson's collection, and a female collected by Blakiston in Yezo, resemble in all essential points

specimens from Shanghai, China, and from Corea. None of them show any inclination toward *T. ruficollis* PALL., being in every respect quite typical.

Measurements.

U. S. Nat. Mus. No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.	Total length.
120332	Henson, 77....	♂ ad.	Hakodate, Yezo.....	Mar. 15, 1884	135	90	17	33	27	....
120333	Henson, 78....	♀ ad.	....do	....do	125	89	18	33	27	....
96291	Blak., 3212....	♀ ad.	Sapporo, Yezo	Oct. 23, 1882	130	93	18	31	27	250

Turdus pallidus GM. (259.)

Mr. Henson sends two specimens, No. 744, Hakodate, November 23, 1885, apparently an old male, and No. 807, November 7, 1885, a younger bird of the same sex. (U. S. Nat. Mus. Nos. 120334–5.)

This species appears to be very rare in Yezo, for it seems that Capt. Blakiston did not obtain it in that island, though he was able to compare a specimen, apparently in the Hakodate museum, with his Chinese examples. Whitely only collected one specimen. These two specimens, with those of Mr. Henson, appear to be the only ones obtained so far in the North Island.

In Hondo the species occurs more frequently, as well as in Kiusiu, and in the Liukiu Islands, though by no means a common bird. All the specimens which I have seen were winter birds, and I do not think there is any valid record of the species breeding in the country.

I can discover no differences beyond individual variation in a series of eighteen examples from the various Japanese islands, Corea, China, Liukiu, and Formosa.

Turdus chrysolaus Temm. (263)

Two specimens from Hakodate (♂ ad., No. 234, May 20, 1885; and a younger unsexed specimen, No. 721, October 4, 1884, U. S. Nat. Mus. Nos. 120336–7) agree with others of the same species from Hondo, Kiusiu, Liukiu, and Corea. The male is perfectly adult, with uniformly dusky throat and without light tips to the greater upper wing coverts; but there are a few dusky spots on the sides of the breast. These are only "recollections," not "remnants," of the first plumage. This specimen is also interesting as being taken later in spring than any of the others examined by me. Compared with the breeding male of *T. jouyi* (July 2) it bears out the difference in the coloration of the throat in the two species, as pointed out in the original description of the latter (Proc. U. S. Nat. Mus., x, 1887, p. 5). I can throw no further light upon this form, and additional specimens of these birds from various parts of Japan, and collected at all seasons of the year, are very desirable.

Turdus obscurus GM. (262)

According to the account given by Blakiston and Pryer, this species, although of regular occurrence, must be comparatively rare in Japan. It has hitherto not been found in Yezo (Blakist., Amend. List B. Jap., p. 26), and Mr. Henson's specimen (No. 1274, ♀ juv.; Hakodate, October 10, 1882) is therefore of particular interest as extending the range of this species into the Northern Island. (U. S. Nat. Mus. No. 120338.)

The scarcity of the Eyebrowed Thrush in the northern portions of Japan is very remarkable, when we consider that it is common in Kamtchatka.

Cichloselys* **sibiricus** (PALL.). (258)

The Siberian Thrush is comparatively rare in Japan, but is found sparingly breeding at least in Hondo. Its occurrence in Yezo has not been recorded with certainty, and Blakiston (Amend. List B. Jap., p. 26) enumerated it among the "Species not found in Yezo or the Kurils." Mr. Henson, however, has been so fortunate as to secure specimens at Hakodate in June, both in 1884 and 1885 (No. 83, ♂, June 3, 1884; No. 159, ♀, June 22, 1885). (U. S. Nat. Mus. Nos. 120339–40.)

The male has not quite obtained its final plumage, for the wing is still more or less tinged with fulvous, and the chin is white, in fact closely resembling a breeding male collected by Mr. Jouy at Fuji, July 14, 1882 (U. S. Nat. Mus., No. 88609). The female is a fully adult bird characterized by the very pronounced plumbeous cast of the back, and by the median upper wing-coverts being uniform and not marked with the buffy deltoid spots characteristic of the bird of the year.

Mr. Seebohm, in the fifth volume of the British Museum Catalogue, gives *Turdus aurorens* PALLAS as the female of the present species, following Gloger, Brehm, and Gray. Looking apart from the locality, Kadiak, as indicated by Pallas, the following points of his description can not be reconciled with *sibiricus:* "Subtus tota ferrugineo-lutea,

*The "Siberian Thrush" has the wing constructed somewhat differently from that of the other Japanese Thrushes. The second primary, as a rule, is very long, nearly, or quite, as long as the fourth; second, third, and fourth thus forming the tip of of the wing. Furthermore, it has only the third and fourth primaries sinuated in the outer webs toward the tips, while in the other Thrushes the fifth is also usually sinuated. The tail in the present species is conspicuously rounded, against square, or nearly so, in the others. With these structural differences there is also associated a peculiar pattern of coloration, especially of the under surface of the wing, which induced Mr. Seebohm to include it in the genus *Geocichla*, in which he also puts *Oreocincla*. To the latter *C. sibiricus* has undoubtedly nearer relationship than to *Turdus*, though there seems to be enough structural characters to warrant the separation of *Cichloselys* and *Oreocincla*.

The name *Cichloselys* was originally applied by Bonaparte to a heterogeneous assemblage of Turdine birds belonging to different groups at that time already named. Since he has not indicated any particular species as type, I feel justified (A. O. U. Code, Canons XXI, XXIV) in restricting the name to the only species of the group requiring a separate name.

versus anum pallidior * * * Remiges nigricantes, margine exteriore luteæ, 2 ad 4 exteriore vexillo angustatæ * * * tectrices secundariarum et incumbentes apice exterius late luteæ * * * Cauda æqualis * * *" In all these points Pallas's description agrees with *Hesperocichla nævia* (GM.) which breeds in Kadiak, Alaska.

Monticola manilla (BODD.). (256)

Blue and Red Rock-Thrush. Iso hio-dori.

1776.—*Turdus solitarius* MÜLLER, Natursyst., Suppl., p. 142 (*nec* LIN., 1758).—*Petrocossyphus* s. DRESSER & SHARPE, B. of Eur., II, pp. 150, 161 (1872).—*Monticola* s. SWINHOE, Ibis, 1874, p. 157.—*M. solitaria* BLAKIST. & PRYER, Ibis, 1878, p. 240.—*Id.*, Trans. As. Soc. Jap., VIII, 1880, p. 225.—*Id., ibid.*, X, 1882, p. 163.—SEEBOHM, Cat. B. Brit. Mus., V, p. 319 (1881).—*Id.*, Ibis, 1887, p. 174.—BLAKIST., Chrysanth., 1882, p. 521.—*Id., ibid.*, 1883, p. 33.—*Id.*, Amend. List B. Jap., p. 58 (1884).—STEJNEGER, Proc. U. S. Nat. Mus., IX, 1886, p. 646.—*Id., ibid.*, X, 1887, pp. 405, 415, 485.—*Id.*, Zeitschr. Ges. Ornith., IV, p. 174 (1888).

1776.—? *Turdus philippensis* MÜLLER, Natursyst., Suppl., p. 145.

1783.—*Turdus manilla* BODDAERT, Tabl. Pl. Enl., p. 39.

1788.—? *Turdus cremita* GMELIN, S. N., I, p. 833.

1788.—*Turdus manillensis* GMELIN, S. N., I, p. 833.—KITTITZ, Mém. Sav. Étr. St.-Pétersb., I, p. 246 (1831).—*Id.*, Denkw., II, p. 186 (1858).—TEMM. & SCHLEGEL, Fauna Jap., Aves, p. 67 (1847).—*Petrocossyphus m.*, HARTLAUB, Journ. Orn., 1854, p. 167.—CASSIN, Proc. Acad. Philada., 1862, p. 314.—*Petrocincla m.* BLAKISTON, Ibis, 1862, p. 319.—WHITELY, Ibis, 1867, p. 199.—*Copsychus manilensis* MARTENS, Preuss. Exp. Ost-As., Zool., I, p. 368 (1877).

1858.—*Petrocincla violacea* SWINHOE, Zoologist, 1858 (p. 6228).

1881.—*Monticola cyanus solitaria* SEEBOHM, Cat. B. Brit. Mus., V, p. 318 (*part*).

1890.—*Monticola cyanus* SEEBOHM, B. Jap. Emp., p. 53.

There has of late been written a great deal in regard to the changes of plumage which take place in the present species, and many theories have been advanced, but no satisfactory solution has been arrived at as yet.

In an elaborate memoir (B. of Eur., II, pp. 149–163, 1872) Messrs. Sharpe and Dresser attempted to demonstrate that the male Blue-and-Red Rock-Thrush is only "blue and red" during a comparatively short transitional period of its life, and that the old birds are entirely blue, like the European Blue Rock-Thrush, basing their conclusion upon the fact that wholly blue birds are found also in the East, in China and Indo-China. Mr. Seebohm, on the other hand, rejects this theory (Cat. B. Brit. Mus., V, pp. 319–320, 1881), and in doing so I think he is absolutely correct. But he solves the mystery of the Eastern blue birds by extending the range of *M. solitaria* (LIN.) (10 ed.=*M. cyanus* LIN., 12 ed.), the European bird, eastward into China, and in this I think he is wrong. The eastern bird is smaller, with a comparatively smaller bill; its wing formula is different, and the blue color is deeper and darker. I have no doubt as to its distinctness, but whether a binominal or only a trinominal should be used to designate it I am at

present unable to say. It seems as if the name *Monticola pandoo* (SYKES) is available for this form.

Sharpe and Dresser (*tom. cit.*, p. 161) indicate the possibility that the Rock Thrush from Japan may turn out to be a different species—characterized by a greater brilliancy of coloration and longer tarsus. Without specimens from the Philippine Islands it is difficult for me to form an opinion. All I can say is that I find no essential difference in proportion or coloration between Japanese, Liukiuan, Formosan, Chinese, and Corean examples. Eleven specimens from China, Corea, and Formosa vary in the wing between 115^{mm} and 128^{mm} (average 122^{mm}) and in the tarsus between 28^{mm} and 31^{mm} (average 30^{mm}), while fourteen specimens from Japan and Liukiu measure in the wing 116^{mm} to 128^{mm} (average 122^{mm}) and in the tarsus 29^{mm} to 32^{mm} (average 30^{mm}).

Mr. Seebohm (Cat. B. Brit. Mus., V, p. 320) asserts that "*males of the year* scarcely differ from adult females, except in having the ground-color of the under parts, especially on the breast and belly, tinged with blue." In this I think he is wrong, for the material before me clearly indicates that the young male in the first autumn is *essentially* like the adult male at the corresponding season. To substantiate this assertion I select from my series four males collected in September and November, viz:

♂ ; Jouy Coll., No. 1177; Chemulpo, Corea, September 7, 1883.

♂ ; U. S. Nat. Mus., No. 86141; Hongkong, China, November 12, 1881; Jouy Coll.

♂ : U. S. Nat. Mus., No. 85830; Kowloon, China, September 28, 1881; Jouy Coll.

♂ : U. S. Nat. Mus., No. 85831; Amoy, China, September 18, 1881; Jouy Coll.

The first two specimens at once proclaim themselves as young birds by the comparatively abraded condition of wings and tails. In the young birds the remiges and rectrices remain from the first plumage, and are not shed in autumn, as in the old birds; hence the fresher condition of these feathers in the latter. I need hardly add that the comparatively abraded quills here spoken of are not those of old birds with these feathers yet unmolted, for in that case they would have been uniform blackish with dark bluish edges and no white, while those I refer to have very broad and light edges, white at the tips. The condition of the quills at this season is a certain indication of the age of the bird when no trace of the first plumage is left. Such a trace, however, is still visible in the Corean example enumerated above, for this specimen has on each tail-feather (central pair absent) a rufous, somewhat heart-shaped, but ill-defined spot near the tip, separated from the broad terminal margin of similar color by a blackish line. In the Hongkong specimen traces of the same are still visible, but the tail is more abraded. The very fresh condition of the corresponding quills in the two other specimens testifies to their having been but recently acquired; the birds are consequently more than a year old.

The two specimens of each group mentioned above agree in every point. The differences between the two groups, which reveal themselves upon closer examination, may be tabulated as follows:

Adult ♂♂.	♂♂ in first autumn.
Bill blackish throughout.	Bill horny brown, basal half of lower mandible particularly pale.
The drab-colored portion of the upper parts extends only to the middle of the back, and the subapical dusky band to the feathers on head, neck, and interscapulars is very indistinct.	The drab color of the upper parts extends nearly to the rump, and the subapical dusky band to the feathers is very pronounced, causing a distinct scaly appearance.
Blue of lower back, rump, upper tail-coverts, and under parts deeper and purer, with fewer and narrower terminal markings of blackish and pale drab-gray.	Blue of rump, upper tail-coverts, and under parts paler and dingier, with the markings more numerous, broader, and more distinct.
Brown of under parts with fewer and narrower terminal markings.	Brown of under parts with more numerous and broader markings.
A distinct bluish supraloral streak, and a ring of similarly colored feathers round the eye.	A distinct whitish supraloral streak, and a ring of similarly colored feathers round the eye.
Wing feathers black with blue edgings of same tint as rump, and narrow white margins to the tips.	Wing feathers blackish brown with pale smoke-gray edgings and broad white margins to the tips, these white tips being particularly broad on primary and greater coverts.
Tail without any particular mark near tip.	Tail with marks as described above.

There is no doubt that Mr. Seebohm (*op. cit.*, p. 320) is correct in the main in asserting that the males during [February and] March cast off the terminal and subterminal bars to the feathers, which they assumed at the autumnal molt, leaving the bird in full breeding plumage. But his material must have been deficient when he states that "in the chestnut feathers [of the autumnal plumage] traces only of the subterminal dark bars are observable." He can have had no fully molted male, for in such a one he would have found not only the pale terminal bar but also a bluish one preceding the dusky bar.

Measurements.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.
Tokio Educat....	Tasaki.....	(♀)...	"North part of Liukiu"	.....	117	79	20	31	30
Christiania, N....	Petersen, 1....	♀.....	Urakami, Kiusiu.....	Dec. 11, 1885	121	80	23	32	30
U. S. Nat., 120341.	Henson, 23....	(♀)ad.	Hakodate, Yezo.....	July 18, 1885	123	81	20	29	....
U. S. Nat., 114663.	Jouy, 1522....	♂ad ..	Tsushima	May 26, 1885	129	84	22	31	29
U. S. Nat. 111664.	Namiye, 3b ...	♂ad ..	Miyakeshima, Idzu ..	May 3, 1887.	128	85	22	31	29
U. S. Nat., 21148.	Stimpson, γ183	(♀) ...	Oshima.....	Jan., 1855 ..	120	81	....	31	29
U. S. Nat., 21146.	Stimpson, γ169	(♂)ad.	Liukiu.....	.....	123	84	22	29	28
U. S. Nat., 21147.	Stimpson, γ165	(♀) ...	Liukiu.....	.....	116	78	22	30	28
U. S. Nat., 109473.	Namiye.....	♀.....	Napa, Liukiu.....	Mar. 5, 1886	120	80	23	30	30
U. S. Nat., 96277.	Ringer, 6	♂juv .	Nagasaki, Kiusiu.....	Oct. 30, 1876	122	80	21	30	30
U. S. Nat., 96276.	Blak., 1326....	♂ad ..	Hakodate, Yezo.....	May ——— ..	128	84	21	30	28
U. S. Nat., 96278.	Blak., 1329....	♀ad ..	Hakodate.....	May ——— ..	121	84	21	30	27
U. S. Nat., 114727.	Ringer, 14.....	♂ad ..	Kiusiu	Jan. or Feb.	122	78	22	31	27
U. S. Nat., 114728.	Ringer.....	♀.....	Kiusiu	Jan. 21, 1887	122	84	20	30	29

Phœnicurus auroreus (PALL.). (253)

♂ ad., No. 105, Hakodate, Nov. 8, 1883; ♀ ad., No. 337, *ibid.*, Sept. 17, 1883. U. S. Nat. Mus., Nos. 12345–6.

Identical with birds from the southern islands and from China. Young Japanese birds in the first plumage are among the desiderata of the U. S. National Museum.

Ianthia cyanura (PALL.). (251)

♂ ad., No. 161, Hakodate, Nov. 5, 1883. ♀♀ ad., No. 162, May 5, 1884; No. 967, April 29, 1884. U. S. Nat. Mus., Nos. 120344, 120359–60.

U. S. National Museum would like to get young birds in the first plumage.

Melodes calliope (PALL.). (252)

Two ad. ♂♂, No. 219, Hakodate, Oct. 8, 1884; No. 793, *ibid.*, Sept. 12, 1886. U. S. Nat. Mus., Nos. 120342–3.

Quite similar to the scarlet-throated males from Kamtchatka, China, Nagasaki, and the Yayeyama Islands. These are all characterized by having the lower fore-neck and upper breast more or less olive-gray (Ridgw., Nomencl. Col., pl. ii, no. 14), and the first one or two rows of feathers back of the scarlet throat pure white with a blackish band across the tips. Two scarlet-throated birds collected by Capt. Blakiston in Yezo (♂, U. S. Nat. Mus., No. 96269, Yubutz, May 18, 1882; Blak., No. 2858. ♀, Mus. No. 26271, Mukawa, May 26, 1882; Blak., No. 2862) differ considerably from all the other specimens before me. The whole under parts are lighter and whiter medially; the gray is entirely absent on lower fore-neck and breast, these parts being of a very pale clay color (Ridgw., Nomencl. Col., pl. v, no. 8); and there are only a few grayish spots to indicate the blackish band noted above. Both of Blakiston's birds are collected in May, but some of the other specimens are obtained during the same month, or even later in the summer, so that season does not seem to have anything to do with this difference, but it may be that it is due to age. At all events, here is an interesting question well worth the attention of the Japanese field ornithologists. Does the Ruby-throated Nightingale breed in Yezo or in the Kurils, and, in such a case, how are the breeding birds colored with reference to the above differences? The young in the first plumage of this common bird are apparently yet unknown and would be a great prize. Not being on the mainland of Kamtchatka at the proper time, I myself was unable to secure any in that plumage.

Larvivora cyane (PALL.). (250)

Of this species Capt. Blakiston says (Chrysanth., February, 1883): "This is by no means an abundant species in Japan, and I know of only one female specimen, which is in the Education Museum;" and during his many years of collecting in Japan he only obtained one speci-

men. Mr. Jouy secured a breeding male not yet in full plumage on Fuji-Yama, and he and Mr. Smith collected two young males at Chiusenji Lake. Mr. Henson has been more fortunate, for he has placed before me not less than twelve specimens from Hakodate, viz, four fully adult males, one male in the second spring, one male in the first autumn, and six females. The dates and numbers of these specimens will be found in the subjoined table of dimensions.

The specimen which I take to be a young female of the previous year (No. 1405), because it has quite distinct tawny terminal edges to the greater wing-coverts, is similar to the young males in the first autumn, except that there is hardly any blue on the upper parts, which, besides, are more tawny. The tail also is dull russet olive above, but a few of the upper tail coverts are strongly suffused with dull indigo. These feathers are only scattered and placed asymmetrically, and as they do not seem to have been molted very recently, I suppose that they have grown out to replace feathers accidentally lost. It may therefore be that in the first spring the females assume the blue rump by actual molt. It is possible, however, that the blue is assumed without a molt, and I may mention that in the other female specimens before me there is a great amount of individual variation in regard to the extent and intensity of the blue color. All these I take to be fully adult birds which have passed the molt of the second autumn, as the wing coverts are quite uniform without any trace of tawny tips. In No. 1401 the blue mark is rather strong, but confined to the lower rump, upper tail-coverts, and upper side of tail, contrasting strongly with the olive of the back. No. 1392 is quite similar, but on upper tail-coverts and tail the olive is much more pronounced. In Nos. 1482 and 1490 the blue is much paler, and it contrasts much less with the back, which is also slightly suffused with a faint tinge of indigo, which in the latter is quite pronounced on some of the wing-coverts. Finally, No. 1488 has no distinct blue in its plumage, the upper tail-coverts being, in fact, strongly marked with tawny. Yet its perfectly black bill and the uniformly colored wing-coverts, as well as the absence of well-marked dusky scaling on the lower parts, prove it to be an old bird. Generally speaking, these adult females may be said to resemble the young males as described by Capt. Blakiston, but with the blue color more restricted and less extensive, with the buffy mark on the lower parts less bright, and with the dusky margins to the jugular feathers less distinct.

It appears that in the first spring, that is, when a little less than a year old, the young males assume the blue plumage of the old male. The quills not being shed at this molt remain as in the young plumage until the following autumn, the tawny marginal tips of the great coverts being very conspicuous by contrast. In this transition plumage they undoubtedly breed, for the breeding bird which Mr. Jouy collected at Fuji, July 14, 1882 (U. S. Nat. Mus., No. 91457), is in this stage. The wings are very much abraded and the tawny tips to the great wing-

coverts nearly worn off; but Henson's bird (No. 1576), which was taken earlier in the season, is perfect in this respect, even more so than the bird from Idzu (U. S. Nat. Mus., No. 109337). The two latter birds exhibit another trace of youth, viz, a strong mark of buff on the sides of the abdomen. Of this color there is hardly a trace in Jouy's bird.

Measurements.

U. S. Nat. Mus. No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.	Total length.
109337	Namiye	♂horn	Amagisan, Idzu, Hondo.	May 3, 1885	75	48	11	27	19	....
91457	Jouy, 513	♂horn	Fuji, Hondo	July 14, 1882	73	47	12	25	19	....
91377	Jouy, 660	♂juv	Chiusenji Lake, Hondo.	Sept. 3, 1882	74	46	12	26	21	....
96264	Jouy, 662	♂juv	do	do	76	51	12	26	21	....
96263	Blak., 1267	♂ad.	Hakodate, Yezo	May 9, 1873	77	51	12	26	20	137
120347	Henson, 160	♂ad.	do	May 15, 1884	74	47	11	27	18	....
120348	Henson, 1500	♂ad.	do	May 19, 1885	75	50	11.5	27	19	....
120349	Henson, 1577	♂ad.	do	June 7, 1885	74	47	12	26	19	....
120350	Henson, 1603	♂ad.	do	June 30, 1886	77	51	12	26	19	....
120351	Henson, 1576	♂horn	do	June 7, 1885	74	47	12	27	20	....
120352	Henson, 1144	♂juv.	do	Sept. 9, 1884	76	50	11	26	20	....
120353	Henson, 1392	♀ad.	do	May 20, 1885	75	47	11	25	19	....
120354	Henson, 1401	♀ad.	do	do	74	50	11	25	20	....
120355	Henson, 1482	♀ad.	do	May 30, 1885	77	50	12	25	20	....
120356	Henson, 1488	♀ad.	do	May 26, 1885	74	47	11.5	25	19	....
120357	Henson, 1490	♀ad.	do	May 30, 1885	72	46	11	25	19	....
120358	Henson, 1405	♀horn	do	May 23, 1885	74	47	12	26	19	....
	Average measurements of 11 males				75	49	11.7	26.3	19.5	....
	Average measurements of 6 females				74	48	11.4	25.2	19.3	....

Pratincola maura (PALL.). (254)

Eastern Stonechat. Nobitaki.

1773.—*Motacilla maura* PALLAS, Reise Russ. Reich., II, (p. 728).—*Pratincola m.* SHARPE, Cat. B. Brit. Mus., IV, 1879, p. 188.—SEEBOHM, Siberia in Europe, (p. 117) (1880). *Id.*, B. Jap. Emp., p. 57 (1890).—BLAKISTON, Chrysanth., 1882, p. 473.—*Id.*, *ibid.*, Jan., 1883, p. 33.—*Id.*, *ibid.*, Feb., 1883, p. —.—*Id.*, Amend. List B. Jap., p. 16 (1881).— JOUY, Proc. U. S. Nat. Mus., VI, 1883, p. 280.

1835.—*Saxicola rubicola* TEMMINCK, Man. d'Orn., 2d ed., III, pp. li, 170 (*nec* LIN.).—TEMM. & SCHL., Fauna Jap., Aves, p. 58 (1847).—*Pratincola r.* BLAKISTON, Ibis, 1862, p. 318.

1863.—*Pratincola rubicola* var. *indica* SWINHOE, P. Z. S., 1863, p. 291 (*nec* BLYTH?).

1863.—*Pratincola indica* SWINHOE, P. Z. S., 1863, p. 335 (*nec* BLYTH?).—*Id.*, Ibis, 1874, p. 155.—WHITELY, Ibis, 1867, p. 197.—BLAKIST. & PRYER, Ibis, 1878, p. 240.—*Iid.*, Trans. As. Soc. Jap., VIII, 1880, p. 225.—*Iid.*, *ibid.*, X, 1882, p. 162.

Notwithstanding all that has been written in regard to the Eastern Stonechats, there is still considerable doubt both in regard to the distinctness of the several forms and their characters and to the names to be applied, if they be considered distinct.

The question whether the Eastern birds are different from the European *Pratincola rubicola* (LIN.) is easily disposed of. The latter

(*i. e.*, the adult male) has generally the rump striped with blackish, and on the lining of the wing the white predominates. In Eastern birds the rump is in most cases unspotted, and black predominates on the under wing-coverts. These characters are now generally admitted. It may be added that the brown margins to the feathers on the upper surface in British examples are much darker than in Indian, Chinese, Korean, and Japanese specimens, and that the under surface is also deeper colored. But there is a character, hitherto apparently overlooked, which, so far as my experience goes (thirty-eight specimens), trenchantly separates the two species. On comparison it will be found that the European birds have the bill much narrower at the base than the birds from the East. Even the young in the first plumage can be easily told apart by this character. Considering this fact and the many points in which the two forms disagree, I refuse to adopt a trinominal appellation for the Eastern birds, the more since it seems as if the breeding habitats of the two species are separated by a belt of country about 600 miles wide. (Cf. Severzow, Journ. f. Orn., 1873, p. 360, footnote.)

Now, concerning the latter, it may be said that Maj. Biddulph (Ibis, 1882, pp. 272–276; Stray Feath., x, 1882, pp. 263–266) has made out a pretty strong case for those gentlemen, headed by Mr. W. E. Brooks, who insist upon the existence in India of two forms of Stonechats, both with unspotted rumps. He states that he was able to separate his birds in two series. In series *A* the males are characterized by absence of white on the nape concomitant with larger size (wing 2.70 inches to 3 inches = 68.6^{mm} to 76^{mm}), the females by brighter colors and larger size (wing 2.55 to 2.70 inches = 64.8^{mm} to 68.6^{mm}); the males of series *B* have the white patch on the sides of the neck extending "round to the back, meeting the white from the other side, so as to form a complete demicollar when viewed from above," their wings varying between 2.52 and 2.75 inches (= 64^{mm} and 69.8^{mm}); the females of the latter form are "altogether of a much darker tone," with the length of the wing 2.35 to 2.60 inches (= 59.9^{mm} to 66^{mm}). Five specimens of somewhat intermediate size he was "unable to separate by differences of color." Then he concludes as follows: "Now, it can not be denied that these measurements overlap considerably, especially among the females; but the fact remains that, after separating forty-three specimens solely by color and markings (omitting the last five undetermined), those of one form average considerably larger than those of the other, and that the greatest divergence in color is shown between those which differ most in size. It may be that the specimens that overlap in measurement are to be accounted for by hybridism—an explanation that no ornithologist can affect totally to ignore when treating of two very closely allied species found in the same locality; or it may be that some of those classed as females would have been found by more careful examination to be males that had not got rid of female

plumage. Whatever may be the explanation of this, I believe that we have here two species. The smaller species of Chat, which I have called form *B*, is evidently *P. indica* of Blyth."

In view of Maj. Biddulph's statements, we are, therefore, obliged to recognize two Indian forms of Stonechats, although not without some doubt, for it appears from his own words that the sex of the specimens has not been determined beyond doubt, and the two forms appear to occur in the same localities at the same season. In regard to the latter point, however, I may recall the case of *Cettia cantans* and *C. cantillans*, while, on the other hand, it is not absolutely clear from his notes whether the two forms *breed* in the same locality. Unfortunately, I have no authentic male specimens from India proper by which to test his conclusions, for three specimens collected by Bingham in Tenasserim appear to agree with Chinese examples to be mentioned later on. I may remark, however, that I am unable to distinguish a female said to be from Nepal (U. S. Nat. Mus., No. 95613) from other small Eastern specimens.

A comparison of my Japanese, Chinese, and Tenasserim specimens (to be called series *C*) with Biddulph's exposition leads to the conclusion that they agree with the smaller form (*B*) in size (see table of dimensions below), while in color they conform to the larger form (*A*), that is to say, the males have no white on the nape, and the females are brightly colored. It thus appears that we have three different forms of Eastern Stonechats, viz:

♂ No white on nape; ♀ bright. { Form *A*, size large. / Form *C* } size small.

♂ White on nape; ♀ dull.....Form *B* }

We may now proceed to determine the names of these three forms. Mr. Brooks and Maj. Biddulph have identified "form *B*" with *P. indica* Blyth, and as this seems to be the general opinion, and as nothing is known to the contrary, we have to accept this name.* He seems uncertain.

Gmelin (S. N., I, p. 997) describes *Motacilla tschecantschia* as "*nucha albicante, torque et macula alarum oblonga albis*," but the original description and plate by Lepechin, upon which Gmelin's diagnosis is founded, being inaccessible to me, I am unable to ascertain the true status of this name whether belonging to the smaller or the larger form. I have no access to the original description in Pallas's "Reise," but from his "Zoographia" it is evident that he imposed the name *M. maura*, by a mistake, and that he really regarded the European and Asiatic birds as belonging to the same species. Since the length of the wing, however, as given by him, equals 66.6^{mm}, or about the average

* *Pratincola indica* Blyth, Journ. As. Soc. Bengal, xvi, 1847, p. 129. It is difficult to see why Hodgson's *Saxicola saturatior* (Gray's Zool. Miscell., 1844, p. 83) should not be used, unless it is a nomen nudum.

of the males of "form *C*," and since the description only speaks of white on the sides of the neck and not on the nape, we conclude that *M. maura* belongs to the smaller form without white on the nape, consequently to "form *C*." There remains now only to determine the name of the large "form *A*." By some Indian ornithologists it has been designated as "*P. robusta* TRISTRAM," but, as shown by Mr. Hume (Stray Feath., IX, 1880, pp. 133, 136), this name belongs only in part to our bird. Rev. Tristram originally (Ibis, 1870, p. 497) gave this name to two alleged Indian specimens of Stonechats, one of which belonged to the present large form of *P. maura*, while the other represents an entirely different species, which Oates now shows to be the larger form of *P. sibylla* from Madagascar (Fauna, Brit. Ind., Birds, II, 1891, p. 58). Mr. W. E. Brooks seems to have intended to name it, for Mr. Hume says (*op. cit.*, p. 136): "Mr. Brooks persistently urges me to assign a separate specific name to this form, and he declares that if I do not, *he will*," but I am unaware that Mr. Brooks has done so.

Since the above was written and set in type I find that Dr. Th. Pleske has discussed the same question and come to similar results (Wiss. Res. Przewalski, Zool., Vög,, pp. 46, seqs.), but too late for any other notice than the adoption of his name for "form A," the names of the three then being as follows:

1. *Pratincola maura* ("form *C*");
2. *Pratincola maura indica* ("form *B*");
3. *Pratincola maura przewalskii* ("form *A*").

In Japan only the small form, without white on the hind neck, occurs. This is very fortunate, as the name of the Japanese birds will remain unaffected, whatever be the fate of the Indian races.

As to Mr. Henson's specimens, I would call attention to the fact that the two adult males collected on August 30, are molting both quills and contour feathers, No. 194 having already finished the molt of the former. Their coloration is considerably brighter and redder than that of the October specimen in the National Museum (No. 96274); the broad light margins to the feathers of the throat are particularly bright, being of a rich vinaceous cinnamon in No. 193, and but slightly paler in No. 194.

I have above already indicated the chief color differences between the European *P. rubicola* and the Asiatic *P. maura*, at least so far as the old males are concerned. The material before me suggests another and very striking difference in the coloration of the females and the young males.

On the 5th of July, 1882, Mr. P. L. Jouy collected at Fuji a *breeding* female (U. S. Nat. Mus, No. 88637) in very abraded plumage. The whole upper side is nearly uniform dull sepia-brown; the light edges to the wing feathers are nearly worn away, and the under surface is a dirty dull buff strongly marked with tawny on the breast; *chin, throat, and upper jugulum is of the same dirty buff as the abdomen, though somewhat more whitish without trace of dusky or dark brownish.* Identical with this

specimen is Henson's No. 90, collected near Hakodate, June 20, 1884, and determined by him to be a female. The only difference is, that the throat is slightly suffused with the tawny of the breast, *but there is no trace of dusky or dark brownish on chin, throat, or jugulum*. Nor have I found it otherwise in any of the eastern specimens before me designated as females. On the other hand, the only European female *P. rubicola* before me (U. S. Nat. Mus., No. 18751) has the chin, throat, and upper jugulum brownish black with narrow pale margins to the feathers. Naumann, moreover, on plate xc (Naturg. Vög. Deutschl., III), and Dresser, on plate xl (Birds of Eur., II), likewise figure the adult females as having the parts named more or less blackish brown, and so describe them. In Yarrell's "British Birds" (4th ed., Newton, I, p. 343) the adult female is described as having the "chin buff, throat blackish." These descriptions and figures refer to the breeding plumage, for after the autumnal molt the light margins to the feathers of the throat are so broad as to totally or nearly totally conceal the blackish base; and females in this plumage (November) are described by Macgillivray (Hist. Brit. Birds, II, p. 281) as having the throat "light grayish brown." The blackish on the throat, therefore, only appears in spring, when the margins become worn towards the breeding season. But it will be observed that the females of *P. maura*, which I have referred to, are in the most possibly abraded plumage, their throat feathers being light colored down to the plumbeous bases.

And as with the adult females, so with the young males. Several specimens so marked by the collectors (U. S. Nat. Mus., No. 86123; and Jouy's Corean examples) have the throat uniform buffy in the first autumnal plumage, with no black at the base, and Henson's No. 782, collected in June, and in a wretchedly worn plumage, has the throat quite as whitish as the females quoted above, being in every respect a counterpart of them. The young *P. rubicola*, on the contrary, appears to assume at once a plumage which is but slightly different from the old males (Naumann, *tom. cit.*, p. 888), with the throat more or less blackish.

Measurements.

U. S. Nat. Mus. No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.	Total length.
120361	Henson, 89	♂ ad	Hakodate, Yezo	June 20, 1884	64*	46*	10	22	18	....
120362	Henson, 194	♂ ad	do	Aug. 30, 1886	68	52	10	22	18	....
120363	Henson, 193	♂ ad	do	Aug. 30, 1886	(†)	(†)	10	21	19	....
120364	Henson, 125	♂ jun	do	Aug. 23, 1885	67	49	10	22	20	....
120365	Henson, 762	♂ horn	do	June 3, 1885	64*	48*	11	22	19.5	....
96275	Blak., 3209	♂ ad	Sapporo, Yezo	Oct. 23, 1882	68	49	10	21	.....	132
88636	Jouy, 312	♂ ad	Fuji, Hondo	June 27, 1882	68	51	10	22	18	....
88637	Jouy, 430	♀ ad	do	July 5, 1882	64*	48*	10	21	19	....
120366	Henson, 90	♀ ad	Hakodate, Hondo	June 20, 1884	63*	47*	10.5	21.5	18.5	....

*Very worn. †Molting.

Measurements—Continued.

U. S. Nat. Mus. No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.	Total length.
96490	Blak., T, 51	♂ ad	Canton, China	April ——	69	52	10	21.5	19	....
96491	Blak., T, 52	♂ ad	do	October ——	68	53	9	.....	.....	145
86123	Jouy, 186	♂	Hongkong, China	Oct. 23, 1881	68	52	9.5	22	19	....
86153	Jouy, 216	♂ ?	do	Dec. 11, 1881	68	49	.....	21.5	18	....
86124	Jouy, 187	♀	do	Oct. 23, 1881	67	49	10	21	19.5	....
95299	Bingh., 483	♂ ad	Tenasserim	Dec. 27, 1879	63	47	10	21	18	....
95298	Bingh., 483	♂ ad	do	Jan. 14, 1880	66	48	10	22	20	140
95300	Bingham	♀ ad	do	Nov. 13, 1879	65	49	10	21.5	.....	135
114378	Jouy, 1390	♂ ad	Fusan, Corea	Apr. 20, 1884	68	48	10	21.5	19	....
114382	Jouy, 1497	♀ ad	do	Apr. 24, 1885	67	47	9.5	22	18	....
114381	Jouy, 1574	♀ ad	do	Apr. 11, 1886	66	47	9.5	21.5	19	....
	Average measurements of 14 males				67	49.5	10	21.6	18.8	....
	Average measurements of 6 females				65	48	10	21.4	18.8	....

Cyanoptila bella (Hay). (207)

Blue-and-black Flycatcher. Oruri.

1829.—*Muscicapa cyanomelana* Temminck, Pl. Color., III, livr. 79, pl. 470 (*nec M. cyanomelas* Vieill., 1818).—Temm. & Schl., Fauna Japon., Aves, p. 47 (1847).—Blakist., Ibis, 1862, p. 317.—*Hypothymis c.* Martens, Preuss. Exp. Ost-As., Zool., I, pp. 94, 368 (1866-1876).—*Cyanoptila c.* Blakist. & Pryer, Trans. As. Soc. Jap., VIII, 1880, p. 215.—*Iid., ibid.*, X, 1882, p. 147.—*Xanthopygia* (*Cyanoptila*) *c.* Blakist., Chrysanth., 1882, p. 523 (scr. *Xanthrop.* err. typ.).—*Id., ibid.*, 1883, p. 29.—*Xanthopygia c.* Blakist., Chrysanth., Feb., 1883, p. —.

1845.—*Muscicapa gularis* Temminck & Schlegel, Fauna Japon., Aves, p. 43, pl. XVI (*nec* Stephens, 1824).

1845.—*Muscicapa bella* Hay, Madr. Journ. Lit. Sc., XIII, p. 158 (fide reprint in Tweeddale's Orn. Works, p. 10 (1881), where, by misprint, "p. 162").

1847.—*Cyanoptila cyanomelanura* Blyth, Journ. As. Soc. Bengal, XVI (p. 125).—*Id.*, Ibis, 1870, p. 164.

1847.—*Muscicapa melanolenca* Temminck & Schlegel, Fauna Japon., Aves, pl. xvii, D.

1860.—*Niltava cyanomelana* Swinhoe, Ibis, 1860, p. 58.—Seebohm, B. Jap. Emp., p. 59 (1890).—*Muscicapa c.* Whitely, Ibis, 1867, p. 199.—*Cyanoptila c.* Blakist. & Pryer, Ibis, 1878, p. 234.—Blakist, Amend. List B. Jap., p. 49 (1884).—*Xanthopygia c.* Sharpe, Cat. B. Brit. Mus., IV, p. 251 (1879).—Jouy, Proc. U. S. Nat. Mus., VI, 1883, p. 306.—Seebohm, Ibis, 1884, p. 180.

1879.—*Cyanoptila cyanothorax* "Leiden Museum" Sharpe, Cat. B. Brit. Mus., IV, p. 252.

Muscicapa cyanomelana and *M. gularis* both being untenable according to the A. O. U. Code, Canon XXXIII (p. 47), Lord Arthur Hay's (*i. e.* Lord Walden—Marquis of Tweeddale) *Muscicapa bella* seems to be the first available name for this species.

Mr. Henson's series of this species, consisting of one old male, one young male, and two adult females, is very interesting as bearing

directly upon the somewhat vexed question of the different plumages of this species.

The two females are both old birds, as they show no trace of light terminal margins to any of the upper wing-coverts, but, although shot on the same day (May 20, 1885), one (No. 1381) is considerably more ashy than the other (No. 1402). I have observed a similar difference in other specimens; the grayer birds are, perhaps, older than the more fulvous specimens. These old females are without any blue in the plumage, but an adult female in the U. S. National Museum collection (No. 109339, May 5, 1885), which is fully as ashy as Henson's No. 1381, has the feathers on the crown and forehead narrowly tipped with sky-blue, with no trace, however, of this color on rump, wings, and tail. Henson's No. 1381, moreover, shows a trace of albinism, one of the primary coverts in the right wing being nearly pure white.

The old male (Henson, No. 102) is a magnificent bird in the fullest height of plumage; the blue edgings to the wing-feathers are rich and perfect; the under wing-coverts are blue tipped with white; the sides of the breast blue, and the flanks white, heavily spotted with dusky spots washed with blue.

The young male (Henson, No. 1243) shot October 7, 1884, is perhaps the most interesting specimen of the lot. On head, interscapulars, and under parts it is very much like those of the adult female, though slightly more tawny; lower back, rump, wings, and tail, on the other hand, are much more like those of the adult male, being colored with different tints of blue, but the tips of the greater upper wing coverts are margined with pale ochraceous buff. However, a few feathers of the nestling plumage, with pale buffy spots at the tips remain on occiput and upper tail-coverts to prove that the young male molts directly from the spotted first plumage into the one with the blue lower back and rump. The greater upper wing coverts, as well as a few of the lesser ones, are margined at tip with pale ochraceous buff.

With the aid of specimens in the U. S. National Museum we are then able to trace the different change of plumages as follows:

First plumage at leaving the nest.—Feathers on head, interscapilium, and breast, with a subapical ochraceous-buffy spot followed by a terminal dusky margin. This plumage is already described by Mr. Jouy (*loc. cit.*), from whose remarks we note that the sexes are strongly marked already in this plumage, the males having the wings blue, the females brown. He does not say anything of the color of the tail in the nestling male, and we have no specimen at hand, but it is safe to assume that it is blue with white bases, as in the next plumage, since no molt of the rectrices takes place when the nestling plumage is changed. (U. S. Nat. Mus., No. 88616.)

Young males in the first autumn (*cf.* what is said above) have the upper parts of head, neck, and interscapulars nearly a pure raw umber, gradually changing into a tawny olive on the under parts, the middle portions

of which (except across the breast) are white, or whitish; scapulars, lower back, rump, outer webs of tertiaries, and edges of quills and primary coverts glaucuous to verditer blue; upper tail-coverts narrowly tipped with white and marked with a black cuneate shaft streak near the tip; tail-feathers white at base; under wing-coverts gray. (This is the plumage described by Sharpe, *tom. cit.*, p. 252, as "adult female.") U. S. Nat. Mus., No. 91379; Henson, No. 1243.

Young females in the first autumn.—No Japanese specimen being at hand, I describe this plumage from a young female collected by Blakiston at Canton, China, during November (U. S. Nat. Mus., No. 96452; Blakist., No. T, 116). Very similar to the adult female, but more brownish above, the rump being quite russet, and more tawny beneath; tips of greater upper wing coverts and shorter tertiaries margined with pale ochraceous buff. (In the rump of the specimen here described there still remains a feather of the nestling plumage, which clearly proves the age of the bird.)

This plumage is retained during the winter months, which the birds spend in the islands of the Malayan Archipelago, in spring and autumn "passing up and down the coast of China" (they being apparently absent on the Philippine Islands). Shortly before their passage northwards the color of the contour feathers is changed (whether by molt or independent of a molt I do not know), so that the young birds reach Japan in spring in a plumage but slightly different from that of the old ones. The young male before finishing the spring change appears to be described by Mr. Sharpe (*loc. cit.*) as "young male."

Young males in the first spring differ from the old males chiefly in the following points: The outer (distal) greater upper wing-coverts have still the ochraceous-buff terminal margins; the edges of quills and primary coverts are still verditer blue; under wing-coverts gray, more or less tinged with fulvous; sides of breast and flanks fulvous gray. (The birds breed in this plumage. U. S. Nat. Mus., Nos. 91813, 88614.)

Young females in the first spring are probably not very different from the old ones. I have no specimen that can safely be referred to this category, but I am much inclined to think that the more fulvous females alluded to above (Henson's No. 1402) are really the younger ones, and that the light tip margins to the greater wing-coverts disappear earlier in the females than in the males.

The breeding season over, the second autumnal molt, which includes both quills and contour feathers takes place, during which the birds assume the full plumage of the old ones, the color of which is never materially altered. The *old males* then in the second autumn and winter of their life (Henson, No. 102) differ from young spring specimens in having all the upper wing-coverts margined with hyacinth-blue to smalt-blue, the quills edged with "marine" blue; the under wing-coverts blue tipped with white, sides of breast black tinged with blue, and flanks white heavily streaked with bluish dusky.

Before leaving this theme I will call attention to the fact that in some of the males the fore neck and breast are pure black, while in others the black is more or less suffused with blue. I am inclined to think that this blue wash is due to the freshness of the plumage, and as it is found both in fall and spring specimens, it may indicate that these feathers are shed twice a year. It does not seem to be due to age.

This explanation has no bearing upon the question in regard to the curious specimen in the Leiden Museum figured in Fauna Japonica plate xvii D, lower figure, which has received the name *Cyanoptila cyanothorax*. In the latter work (p. 47) it is described as being "des teintes beaucoup moins pures. Le noir de la queue s'avance jusque vers la base de cet organe, et le noir des parties inférieures est remplacé par une teinte d'un bleuâtre sale." Blyth describes the same specimen (Ibis, 1870, p. 165) as "having the throat, breast, and ear coverts * * * of a dull whitish color, while the back is strongly tinged with verditer." This hardly represents a regular plumage, much less a distinct species, and Blyth's surmise that it is "probably a female in quasi-masculine attire" is most likely the correct explanation. The absence of black on the fore neck and of white on the tail feathers clearly indicates the female sex; that the females are apt to assume a more or less bluish plumage is illustrated by the specimen alluded to above, which has the feathers on the crown tipped with sky-blue.

Measurements.

U. S. Nat. Mus. No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feather.	Exposed culmen.	Tarsus.	Middle toe with claw.
120367	Henson, 102	♂ad	Hakodate, Yezo	Nov. 12, 1882	92	61	10	18	18
120368	Henson, 1243	♂jun	do	Oct. 7, 1884	89	58	9.5	16	16
120369	Henson 1381	♀ad	do	May 20, 1885	90	59	12	17	17
120370	Henson, 1402	♀ad	do	May 20, 1885	88	58	11	17	17
91813	Jouy, 1064	♂horn	Yokohama, Hondo	Apr. 29, 1883	90	60	11	17	.....
88614	Jouy, 453	♂horn	Fuji, Hondo	July 8, 1882	89	59	11	16	17
91379	Jouy, 638	♂jun	Chiusenji Lake, Hondo	Aug. 30, 1882	94	63	11	16	18
88615	Jouy, 364	♀ad	Fuji, Hondo	June 30, 1882	90	60	11	16	16
109339	Namiye	♀ad		May 5, 1885	87	57	11	16.5	17
88616	Jouy, 614	♀juv	Fuji, Hondo	July 28, 1882	89	59	....	....	.....

Poliomyias ferruginea (GMEL.). (210)

This is the same as Pallas's *M. luteola* and Temminck's *M. mugimaki*, as evidenced, among other things, by Pallas's own synonymy (Zoogr., I, p. 470).

Henson's collection contains not less than five specimens of this bird so rare in Japan, and throws considerable light on the question of sexual differences and seasonal changes in this species. It would have been impossible for me to gain a full and correct idea of these facts, had I not been permitted to examine an unparalleled series of thirty-five specimens collected in Corea by my friend P. L. Jouy. The conclusions

drawn from this collection are particularly valuable, as the preparation is excellent, the labeling full and exact, and the sex ascertained in every instance by dissection.

An examination of all the material before me gives some general results:

(1) The amount of white at the base of the tail-feathers is not entirely due to age, and is subject to an endless individual variation, hardly two individuals being alike. Jouy's No. 1592, Fusan, May 2, 1886, has very little white on the inner webs and scarcely any on the outer web of the outer pair, and yet it is a full-plumaged male with the whole upper surface black; and among the males with olive back there are many with the white in the inner web developed up to the maximum of black-backed ones.

(2) In Mr. Jouy's series twenty-one specimens are marked as males, some are black-backed, others olive-backed, but all *have* white at base of tail-feathers; fourteen specimens are females, all of which are olive-backed, and all *without* trace of white at base of tail feathers. The females have also the color on fore neck and breast considerably paler and duller. The great number shows that this coincidence is not due to an accident, but that we have here expressed the true sexual difference in this species, viz, *males* have white on tail, and throat rich orange-tawny; *females* have no trace of white on tail, and throat dull orange-ochraceous. Against the above series it counts very little that Henson's No. 240 is marked "♀," though having white on the outer webs of the tail feathers and a rich orange-tawny breast and throat; it is a young bird, as evidenced by the two broad light cross bands on the wings, and there is every probability of a mistake in sexing. The same remark applies to Swinhoe's description of a young bird as male, but without white on the tail (Ibis, 1862, p. 305, as *M. hylocharis!*). As far as the coloration of the tail is concerned the sexual difference in this species seems to be the same as in *Cyanoptila bella* (= *cyanomelana*).

(3) This sexual difference in the coloration of the tail holds apparently good even in the first plumage, when the bird is leaving the nest, for Von Schrenck describes and figures a young bird in this plumage (Reis. Amur-L., I, p. 375, pl. xiii, figs. 1, 2), which has the rectrices white in basal third of outer webs, while a young bird in Mr. Henson's collection (No. 1322), labeled female, and still showing traces of the nestling plumage, has no white at all on tail.

(4) There is a considerable difference in the color of the spring and fall plumages of the adult males. After the autumnal molt they are of a bluish slate gray above, somewhat darker on the middle of the back, and the feathers more or less distinctly tipped with olivaceous. When they return in spring, however, the whole upper surface is glossy black. The young males are olive backed, and Swinhoe was consequently in error when considering this stage to represent the winter plumage of the adults.

(5) Mr. Jouy's fourteen females may be divided into two series: (*a*) those with narrow light outer edges to the tertiaries and narrow ochraceous tips to the greater upper coverts; and (*b*) those in which the light edges to the tertiaries are broader and surround the tip; which have very broad whitish tips to the greater coverts and light tips to the median coverts. The latter (*b*) I take to be birds of the year; the former (*a*) I consider adult birds.

The sequence of the different plumages would then be, according to the above:

Nestling plumage spotted; males with white at base of tail, females without; contour feathers molting in September and October.

Young after autumnal molt: Olive above; males bright orange-tawny underneath and with white on tail; females dull orange-ochraceous underneath, without white on tail, broad whitish tips, to greater upper wing coverts. Contour feathers change before the birds leave the winter quarters (Malayan peninsula and Borneo). Whether the black plumage is assumed in spring by an actual molt or by a change of color in the individual feather I can not say without specimens, but the probability is for the latter.

Adult in breeding plumage: Males black above, orange tawny beneath, white on tail; females like young females, but with greater wing-coverts but narrowly margined at tip; by abrasion the plumage of the female turns gray above and buffy beneath. At the next autumnal molt both quills and contour feathers are shed; the males assume a somewhat lighter, more bluish slate color with a wash of olive.

It will be seen that my conclusions differ considerably from those arrived at by Mr. R. B. Sharpe (Cat. B. Brit. Mus., IV, pp. 201, 202), but I can not help thinking that he has been led into error by specimens wrongly sexed by the collectors, and that in reality the bird which he describes as "*adult female*" is but a young male.

Henson's collection contains two fine adult males in black spring plumage; one in the slaty-blue fall plumage; one in olive plumage (marked female); and one young female with traces of the nestling plumage still on shoulders and upper tail-coverts.

Measurements.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.
U. S. Nat., 120371	Henson, 239...	♂ad	Hakodate, Yezo....	May 20, 1885	76	54	8	17	14
U. S. Nat., 120372	Henson, 1552..	♂ad	....do.....	May 20, 1886	73	52	8.5	17	15
U. S. Nat., 120373	Henson, 1297..	♂ad	....do.....	Oct. 12, 1884	76	....	8	16	14
U. S. Nat., 120374	Henson, 240...	♀(?)	....do.....	Oct. 8, 1884	75	52	8	16	14
U. S. Nat., 120375	Henson, 1322..	♀juv	....do.....	Oct. 20, 1884	70	51	8	15	14
U. S. Nat., 91373	Jouy, 731.....	♂jun	Matsumoto, Hondo.	Oct. 29, 1882	74	52	8	15	14

Zanthopygia narcissina (Temm.). (209)

Twenty-seven specimens, the particulars of which will be found below. This series is the most interesting and most convincing one I have ever seen demonstrating the curious and still but little understood change of color in the old plumage without abrasion of the feathers or shedding of their margins, as it takes place in some birds in spring. At the meeting of the German ornithologists in Altenburg, July, 1852, Mr. Leopold Martin demonstrated the fact that the young black and white Flycatchers of Europe exchange their juvenile gray plumage for the adult black one without a molt, and without shedding the margins of the feathers (printed in Journ. f. Orn., 1853, pp. 16–19). Curiously enough, Dr. Hermann Schlegel on the same occasion laid a similar discovery before the same society (printed in Naumannia, II, ii, 1852, pp. 19–40), but unfortunately both gentlemen overestimated the frequency of the phenomenon. Schlegel tried to prove that such a change of color without a molt or marginal shedding takes place in all birds, while the feathers are only molted once a year, viz, in spring; and Mr. Martin, without committing himself positively, expressed a somewhat similar opinion. An animated discussion sprang up in the journals mentioned, in which especially Gloger, Brehm, and Gätke participated, and it was finally conceded on almost all sides that such a change of color takes place in certain birds, but that so far from it being the usual process, the change of color independent of molt or marginal shedding must be regarded as the exception. Schlegel's unwarranted generalization, however, had brought the whole theory into disrepute; the subject was soon dropped, and but few later ornithologists have paid any attention to it, in spite of the fact that it is one of the most interesting questions in ornithology. The great difficulty is in giving a satisfactory physiologic explanation of the process, which to-day is nearly as much of a mystery as it was thirty years ago. People were willing enough to admit the possibility of a change of the color, but it was found that this was accompanied by an apparent renewed growth of the feathers, a process by which the worn and broken plumes seemed to undergo a complete mending or renewal. This phase of the question is admirably illustrated in Henson's series, and I must confess that I am not prepared to accept any of the theories which have been proposed. But although unable to offer a satisfactory explanation of the phenomenon, it will not do to deny the facts, and we must leave the solution of the question to some painstaking physiologist, who shall take up the subject in a careful and empirical manner.

Of Henson's birds eight are males in full plumage, and two adult females; six are young birds after the first autumnal molt, and eleven are spring males in all possible gradations between the young and the adult plumage; one similar bird is in the U. S. National Museum, and one in Petersen's collection from Nagasaki.

It appears from this series that the yellow on the fore-neck appears before any of the other parts change color, for in all the specimens, even in those quite gray on the back and yet without yellow on the rump, the chin, throat, and chest (præpectus), are of a rich orange, paler and more gamboge behind. The yellow superciliary streak is also present in all. The change of the gray feathers to black seems to start on the forehead and the part adjoining the yellow on the fore-neck, for even in the specimens which have undergone the least change (Henson's Nos. 685 and 690) the anterior half of the crown, cheeks, and a narrow band down the sides of the neck bordering the yellow throat are black; the white spot formed by some of the upper wing-coverts has also appeared, and a few of the latter have also turned black; the upper tail-coverts are just changing to black, No. 690 being particularly interesting in showing some of the latter black at the base and russet, as in the young plumage, towards the tips; in these specimens the yellow is just making its first appearance on the rump; both have the remiges still brownish gray, as is also the tail in No. 685; but in No. 690 the tail-feathers are already pure black. It is worthy of remark that the change is not equilateral, nor does it take place regularly or on one side in preference to the other. It is also a noteworthy fact that, while in the European Black-and-White Flycatchers the change is only one from gray to black or white, the recolorescens in *Zanthopygia* also embraces the yellow of an exceedingly bright and rich tint.

No. 680 is like the foregoing ones, but black commences on the left scapulars; the rump is nearly entirely yellow, and the tail black. No. 688 similar; back clouded with black; but tail brownish gray. No. 689 is but slightly more ahead: rump intensely yellow, nearly cadmium; tail black; and the second tertiary in left wing deep black; yellow on breast in this and foregoing three specimens somewhat farther back. No. 677 is black on scapulars and interscapulars, and the tertiaries are just changing; but there is less black in the upper wing-coverts than in any of the foregoing; tail black. No. 691 similar, but blacker on hind neck and wing-coverts, and more yellow on lower breast and abdomen; longer tertiaries brownish gray; tail black. No. 684 differs only in having the tail brownish gray. No. 683 again has the tail and two shorter tertiaries black; otherwise no difference. No. 692 identical. In all the foregoing specimens, as well as in the one in the National Museum and in Petersen's collection, the occiput is still gray. They agree therefore closely with the upper figure in the plate (xvii C) in Fauna Japonica, which gives an excellent idea of these birds in the last stage of transition. It seems, therefore, as if the occiput regularly is the last part of the smaller plumage to assume the black color. No. 693 has finished the change on the body, but the remiges are still brownish gray, except the three tertiaries in the left wing and the two shorter ones in the right; the black on back and upper head, moreover, has a strong wash of olive.

Mr. Henson's specimens are from Hakodate, Yezo, and the dates on which they were collected run as follows in the order in which the specimens have been mentioned above, viz: May 20, June 17, May 17, 23, 6, 27, 18, 18, 17, 30. For comparison it is interesting to note, that Petersen's bird, which has nearly finished the change, was collected in Kiusiu April 29. The change, therefore, seems to take place during May and first half of June.

In the above specimens in which the tertiaries have become black, this color contrasts strongly with the faded brownish gray of the other remiges, and there is no indication of the latter becoming black by a gradual change. In the series of 8 specimens which I have designated as males in "full plumage" there are several in which all the remiges are intermediate blackish brown, paler towards the tip. It would therefore appear as if all the primaries and secondaries change to black simultaneously and that this change takes place very suddenly. The process seems to be the same in the tail-feathers, though I may mention, that Mr. Jouy has a changing male from Korea in which all the rectrices are black or nearly so, with the exception of the middle pair, which is still brownish.

In regard to the young males collected by Mr. Henson I have only to remark that No. 1161 has still a few feathers on the nape belonging to the first plumage, with a buffy spot and dusky margin to the tips.

Measurements.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.	Total length.
U. S. Nat. 120376..	Henson, 687.	♂ ad...	Hakodate, Yezo.	May 23, 1885	78	50	10	17	17	....
U. S. Nat. 120377..	Henson, 686.	♂ ad...	....do	May 17, 1885	76	49	10	16	16	....
U. S. Nat. 120378..	Henson, 681.	♂ ad...	....do	May 18, 1885	79	52	10	16.5	16.5	....
U. S. Nat. 120379..	Henson, 682.	♂ ad...	....do	....do	....	50	10	16.5	.....	....
U. S. Nat. 120380..	Henson, 676.	♂ ad...	....do	May 20, 1885	74	50	10	16.5	16.5	....
U. S. Nat. 120381..	Henson, 694.	♂ ad...	....do	May 23, 1885	76	50	10	16	16	....
U. S. Nat. 120382..	Henson, 679.	♂ ad...	....do	June 9, 1886	77	49	10	17	17	....
U. S. Nat. 120383..	Henson, 678.	♂ ad...	....do	June 6, 1885	77	50	10	17	17	....
U. S. Nat. 120384..	Henson, 690.	♂ trans.	....do	June 17, 1886	76	49	10	16.5	16	....
U. S. Nat. 120385..	Henson, 680.	♂ trans.	....do	June 8, 1886	....	52	9.5	16	16	....
U. S. Nat. 120386..	Henson, 685.	♂ trans.	....do	May 20, 1885	74	49	10	16.5	17	....
U. S. Nat. 120387..	Henson, 688.	♂ trans.	....do	May 17, 1886	76	53	10	17	17	....
U. S. Nat. 120388..	Henson, 677.	♂ trans.	....do	May 6, 1884	79	52	10	17.5	17	....
U. S. Nat. 120389..	Henson, 691.	♂ trans.	....do	May 27, 1885	75	49	10	17.5	17	....
U. S. Nat. 120390..	Henson, 683.	♂ trans.	....do	May 18, 1885	....	49	9.5	16	16	....
U. S. Nat. 120391..	Henson, 684.	♂ trans.	....do	....do	74	49	10	16	16	....
U. S. Nat. 120392..	Henson, 692.	♂ trans.	....do	May 17, 1885	75	50	9	17	16	....
U. S. Nat. 120393..	Henson, 689.	♂ trans.	....do	May 23, 1885	77	51	10	16.5	16.5	....
U. S. Nat. 120394..	Henson, 693.	♂ trans.	....do	May 30, 1885	72	49	9.5	16	15	....
Christiana N	Petersen, 54.	♂ trans.	Shimbon, Kiusiu.	Apr. 29, 1886	75	51	9.5	.....	.....	....
U. S. Nat. 26140..	Blak. 2914...	♂ trans.	Sapporo, Yezo..	June	75	50	10	16.5	16	....
U. S. Nat. 88621..	Jouy, 338....	♂ ad...	Fuji, Hondo ...	June 29, 1882	77	51	10	16.5	16.5	....
U. S. Nat. 88620..	Jouy, 449....	♂ ad...	....do	July 6, 1882	77	50	9.5	.....	.....	....
U. S. Nat. 91380..	Jouy, 719....	♂ jun..	Tate Yama, Hondo.	Oct. 26, 1882	77	50	10	17	17	....
U. S. Nat. 120395..	Henson, 1161	♂ jun..	Hakodate, Yezo.	Sept. 11, 1884	76	50	10	.....	.....	....
U. S. Nat. 120396..	Henson, 1177	♂ jun..	....do	Sept. 15, 1884	72	47	10	17	17	....
U. S. Nat. 120397..	Henson, 1186	♂ jun..	....do	Sept. 17, 1884	76	48	10	16	16	....

Measurements—Continued.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.	Total length.
U. S. Nat. 120398	Henson, 1189	♂ jun.	Hakodate Yezo	Sept. 17, 1884	74	49	10	16	16	....
U. S. Nat. 120399	Henson, 1219	♂ jun.	....do.....	Sept. 23, 1886	78	51	10	17	.....	....
U. S. Nat. 120400	Henson, 1223	♂ jun.	....do.....	Sept. 30, 1884	76	49	9.5	16.5	16	....
U. S. Nat. 120401	Henson, 1351	♀ ad.	....do.....	May 20, 1885	72	47	9.5	16.5	16.5	....
U. S. Nat. 120402	Henson, 1283	♀ ad.	....do.....	May 30, 1885	75	47	9.5	17	.....	....
U. S. Nat. 96139	Blak. 2284	♀ ad.	Mori, Yezo	May 13, 1877	74	50	10	16.5	17	120
U. S. Nat. 109343	Namiye.....	♀ ad.	Amagi, Hondo.	May 12, 1885	73	51	10	16	15.5	....
U. S. Nat. 88622	Jouy, 518....	♀ ad.	Fuji, Hondo...	July 14, 1882	74	48	10	16	16	....
U. S. Nat. 88623	Jouy, 625....	♀ ad.	....do.....	July 30, 1882	73	47	10	16	16	....
Average measurements of 23 males					76	50	9.8	16.6	16.4	....
Average measurements of 6 females					74	48	9.8	16.3	16.2	....

Hemichelidon griseisticta SWINH.

Henson Coll., No. 238; ♂ jun., Hakodate, Yezo; September 1, 1885; U. S. Nat. Mus., No. 120403.

This is a very interesting addition to the Japanese avifauna. It was quite natural that Mr. Henson should mistake this specimen for *H. sibirica* (GM.), when he found that it differed from the common Japanese Gray Flycatcher (*A. latirostris*). It occurred to me that the alleged occurrence of the former species in Japan might also rest on specimens belonging to *H. griseisticta*, but an examination of the skin, upon the identification of which *H. sibirica* has been introduced into the fauna of Japan (Blak., No. 2730, U. S. Nat. Mus., No. 96138; Seebohm, Ibis, 1884, p. 37) proves that it was correctly referred to this species. To which species, however, the two specimens in the Tokio Educational Museum mentioned by Messrs. Blakiston and Pryer (Trans. As. Soc. Jap., X, 1882, p. 148) belong must, of course, remain doubtful until they be carefully examined and compared.* As Henson's specimen has still a few feathers of the first plumage left, it is reasonable to suppose, that *H. griseisticta*, although rather rare, may breed in Yezo.

We have consequently three gray Flycatchers in Japan, which in general appearance are very much alike, and therefore difficult to distinguish unless close attention be paid to their essential characters. The following "key" may assist in identifying the three species.

a[1] First (tenth) primary, very short, much shorter than the primary coverts; second primary longer than fifth; wing more than 75 mm .....(HEMICHELIDON).

b[1] Inner edges of remiges (as seen from below) vinaceous-cinnamon; longer under tail-coverts brownish gray with white tips; breast and flanks clouded with drab-gray.....*H. sibirica.*

*It is even possible that they may belong to a fourth species, the *B. manillensis* of Tweeddale, which seems to have a longer and narrower bill and to be somewhat larger (see farther on).

b^2 Inner edges of remiges (as seen from below) pale drab-gray; longer under tail-coverts entirely white; breast and flanks white with well-defined longitudinal streaks of dark drab-gray ..... *H. griseisticta.*

a^2 First (tenth) primary equal to, or longer than, longest primary coverts; second primary shorter than fifth; wing less than 75mm (ALSEONAX) ... *A. latirostris.*

In proportions, size, and shape of bill my specimens of *H. griseisticta* (as well as my *H. pallens*) agree very closely with *H. sibirica*, so that it is entirely out of question to keep them in two different genera or even subgenera. In fact almost the only structural difference which I can detect is the slightly longer gonys in *H. griseisticta*. I am, therefore, considerably perplexed at seeing Mr. Sharpe referring the latter to the genus *Muscicapa*, next to *M. grisola*, while separating *M. sibirica* as the type of *Hemichelidon*. It seems therefore probable to me that his *M. griseisticta* (Sharpe, Cat. B. Brit. Mus., IV, p. 153) differs from mine, being probably Bonaparte's (or at least Tweeddale's) *Butalis manillensis*, a name which Sharpe quotes in his synonymy, but rejects on account of there being a *Muscicapa manillensis* previously employed.* Judging from Tweeddale's remarks (P. Z. S., 1877, p. 694) there occurs in the Philippine Islands a gray Flycatcher in coloration very much like *H. griseisticta*, but with a bill more like *M. grisola*. Whether Mr. Sharpe or I are wrong in the identification of Swinhoe's name, I cannot say, but I have had for guidance two Chinese examples, one collected by Mr. Swinhoe himself, in March 1861, at Amoy, and marked "*Muscicapa griseisticta*" in his own handwriting, and until the opposite be proven I shall regard this specimen as perfectly typical, and with this the Japanese bird agrees in all the essential particulars.

The measurements of the latter are as follows: Wing, 82mm; tail-feathers, 50 mm; exposed culmen, 8.5 mm; tarsus, 14 mm; middle toe, with claw, 15.5 mm.

Hirundo dasypus (BONAP.). (185)

♂ ad., Henson No. 153; Hakodate, May 16, 1884; U. S. Nat. Mus. No. 120480.

Breast pale, intermediate between "smoke-gray" and "drab-gray" (Ridgway, Nomencl. Col., pl. ii, pp. 12, 13), exactly like adult and young specimens collected by Mr. P. L. Jouy at Fuji, Hondo, July 20, 1880.

Phyllopseustes borealis (BLAS.).

Phyllopseustes borealis xanthodryas (SWINH.).

Material which has come to hand since I wrote my "Results of Ornithological Explorations in Kamtschatka, etc.," and especially the five specimens in Mr. Henson's collection, as well as the example obtained by Mr. Petersen at Nagasaki, have considerably shaken my confidence in *Phyllopseustes xanthodryas* as a good species. Three characters are

*Mr. Sharpe seems now to have adopted Bonaparte's name notwithstanding the earlier *M. manillensis* (cf. Ibis, 1888, p. 200) and from a recent examination of Philippine examples he still considers *B. manillensis* and *B. griseisticta* identical.

given as distinctive of this form, viz, (1) general large size; (2) longer first (rudimentary) primary; and (3) more vivid yellow color of the underparts. Several of the thirty-one specimens before me can be thus distinguished (for instance, U. S. Nat. Mus., No. 92557, Kamtchatka; Nos. 88624, 91374, Hondo, Japan; Jouy, No. 1445, Corea; Henson, Nos. z, *aa*, Yezo, Japan) as true *Ph. xanthodryas*, and U. S. Nat. Mus., Nos. 92551, 92554, 92556 (Bering Island), 88504, 88505 (Amoy, China) Henson, No. *x* (Hakodate, Japan), and all the Alaskan specimens* as *Ph. borealis*, but other specimens will only show one or two of these characters in all possible combinations. Thus U. S. Nat. Mus., Nos. 89158, 106607 (Bering Island), and Petersen's No. 28 (Kiusiu, Japan), are *Ph. xanthodryas* as far as the first primary is concerned, but *Ph. borealis* according to color, while the first mentioned has the size of the former and the two others are not larger than ordinary *Ph. borealis*. Henson's No. *w* (Hakodate, Japan), on the other hand, belongs to the last mentioned form by its general size and the first primary, while it is colored like *Ph. xanthodryas*. Henson's No. *y* (Hakodate) is a *Ph. xanthodryas* by its size, a *Ph. borealis* by its color, with the first primary intermediate. U. S. Nat. Mus., No. 96254 (Blakist., No. 1879; Hakodate) is also a *Ph. xanthodryas* by size, and partly by its color, but its first primary does not reach beyond the longest primary coverts. The result is that if you arrange your birds in two groups according to either one of the three diagnostic characters, the two groups will contain different specimens every time.

It cannot be denied, however, that there is a general tendency in the larger birds to have a proportionally larger first primary and a yellower tint, and it may be that this tendency would be more striking were all the specimens properly sexed. It is also somewhat significant that we

*Three additional specimens from Alaska bear out my suggestion (Res. Orn. Expl. Kamtsch., pp. 303–304) that the Alaskan colony consists of birds of smaller dimensions than those from Kamtchatka and Japan, and that their migration route does not touch these countries. I feel quite confident that the two forms are subspecifically distinct. In evidence I offer the following

Measurements.

U. S. Nat. Mus. No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	First primary.
106650	Townsend, 1165½.	ad.	Kowak R. Alaska	Aug. 1, 1885	60	45	9.5	8
101217	Johnson, 4	ad.	Alaska	June 19, 1884	65	48	.....	9
101216	Johnson, 12	ad.	....do	....do	62	44	10	10
45909	Pease, 178	ad.	St. Michaels, Alaska	Aug. 16, 1886	60	43	.....	9
75416	Nelson, 438	ad.	....do	Aug. 24, 1877	60	42	.....	7
75415	Nelson, 462	♂ad.	....do	Aug. 31, 1877	65	46	.....	9
Average dimensions of 6 specimens					62	45	.....	8.7

find none of the *Ph. xanthodryas* style in the Alaskan series. It is, furthermore, clear from the dates of the different birds, that season has nothing to do with the intensity of the yellow color. I am therefore not prepared to give up *Ph. xanthodryas* entirely, but as intermediate specimens undeniably occur, I shall, at least provisionally, adopt the course already indicated by me on a former occasion (Res. Orn. Expl. Kamtsch., p. 306) calling the yellow bird *Ph. borealis xanthodryas*, in spite of the fact that it is difficult at present to assign a definite habitat to the two forms, as both seem to occur in the same countries.* It is possible, however, that *Ph. xanthodryas* is the breeding bird of Japan, and that *Ph. borealis* only occurs there on the migrations; this is a question for the resident ornithologists there to investigate and solve.

The Japanese specimens of the two forms, as I have provisionally separated them, measure as follows:

Phyllopseustes borealis.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	First primary.	Tarsus.	Middle toe with claw.
U. S. Nat. 96255..	Blakist., 2972 .	ad.	Tomakomai, Yezo .	Sept. 16, 1882	68	47	10	11	19.5	15
Christiania, N ...	Petersen, 28 ..	♂ ad.	Urakami, Kiusire .	Feb. 15, 1886	64	46	10	13.5	20	15
U. S. Nat. 120409.	Henson, *w*....	ad.	Hakodate, Yezo ...	.....	64	48	10	11	18.5	14
U. S. Nat. 120410.	Henson, *x*	ad.	.....do	.....	66	48	10	10	20	14
U. S. Nat. 120411.	Henson, *y*	ad.	.....do	.....	72	51	10	11.5	20	14

Phyllopseustes borealis xanthodryas.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	First primary.	Tarsus.	Middle toe with claw.
U. S. Nat. 88624..	Jouy, 537	♂ ad.	Fuji, Hondo	July 20, 1882	71	52	10	15	21	15
U. S. Nat. 91374..	Jouy, 682	♂ ad.	Chiusenji Lake, Hondo.	Oct. 3, 1882	65	47	11	12	20	15
U. S. Nat. 96254..	Blakist., 1879.	♂ ad.	Hakodate, Yezo ...	Oct. 3, 1875	73	51	11	11	21	....
U. S. Nat. 120412.	Henson, *z*.....	ad.	.....do	.....	70	50	11	13	21	15
U. S. Nat. 120413.	Henson, *aa* ...	ad.	.....do	.....	69	48	....	14	20	16

* Pleske (Ornith. Ross., II, ii, 1889, p. 155) has shown, however, that *Ph. xanthodryas* has only been found in Kamtchatka, the Kuriles, Japan, and Amoy, China, while all the specimens from Siberia are typical *Ph. borealis*, and I have called attention to the fact that the *Ph. xanthodryas* style is not found in Alaska. But the fact remains that *Ph. borealis* also occurs in the countries whence comes the yellow form.

Phyllopseustes tenellipes (SWINH.). (244)

So far only two specimens of this species have been taken in Japan, both at Hakodate. It is, therefore, very interesting to find in Mr. Henson's collection no less than fourteen specimens of this rare bird (U.S.Nat. Mus., Nos. 120414–120427). They were not collected by Mr. Henson himself, but by a native, and are therefore neither dated nor sexed, but "they were all netted on the hill behind Hakodate." So far as I can judge they are all in spring plumage.

The question now naturally arises: Where is the real habitat of this species? Mr. Seebohm (Cat. B. Br. Mus., V, p. 47) supposes it to breed in Japan, evidently upon the strength of Whitely's specimen having been collected in May. But if it breeds in Yezo, is it probable that it could have so entirely escaped both Capt. Blakiston and Mr. Henson? Pleske, on the other hand, asserts that *Ph. tenellipes* breeds in Sakhalin (Orn. Ross., II, pt. 2, p. 191). In view of these facts it seems probable that *Ph. tenellipes* only passes Yezo during the spring migration, and not even then regularly.

Urophlexis* **ussuriana** (SEEB.). (234)

Four specimens in autumnal plumage, from Hakodate.

I am somewhat doubtful as to the correctness of this identification. Seebohm, in 1881 (Cat. B. Brit. Mus., V, p. 143), separated a specimen collected in Ussuri from *U. squameiceps* (SWINH.) as "*Cettia ussurianus*" on account of the more olive cast of the plumage of the latter (*squameiceps* being described as "chocolate brown," by which term he probably intends to designate a more rufescent cast). Since then he has examined many Japanese specimens, and in 1890 (B. Jap. Emp., p. 74) he still maintains this distinction, referring, as he does, the Japanese birds to typical *U. squameiceps*. If we compare Swinhoe's description in Ibis, 1877, p. 205, and figure on pl. iv, Seebohm's measurements (Cat. B. Br. Mus., V, p. 143) and Oates's statement (B. Ind., I, p. 442) in regard to the graduation of the tail, with the results of our own measurements of eleven Japanese and Korean specimens, as given below, we shall soon gain the conviction that the latter differ from the Formosan and the Tenasserim birds. The average graduation of the tails of the former is 2^{mm} (maximum 3^{mm}), while Seebohm's Formosa skin has the tail graduated 6^{mm}. In other words, while the tail in *U. squameiceps* is nearly wedge-shaped, those of the Japanese and Korean birds are barely rounded. Now, Seebohm's measurements of *Cettia ussuriana* show that this bird has the tail rounded like the Japanese and Korean specimens. Leaving coloration out of consideration it would therefore seem as if we had at least two forms, one with a very rounded tail and another with the tail nearly even. As to the alleged difference in color, it may

* *Urosphena* SWINHOE is preoccupied. The above substitute is derived from *ουρα*, tail, and *φλεξίς*, the name of an unknown bird.

be observed that only one specimen of typical *U. ussuriana* has been critically compared, so far as I know. Furthermore, the Korean examples differ in no way from Japanese specimens; and finally, some specimens in my series are slightly less rufescent than others. Until it be proven that there is an appreciable difference in the coloration of the even-tailed birds I shall regard them as all entitled to the name *U. ussuriana*.

Measurements.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.	Graduation of tail.	Total length.
Sc. Coll. Tokyo 1374	Ota	ad.	Fuji, Hondo		52	28	11	20	16	1	....
U. S. Nat. 91456	Jouy, 490	♂ ad.	....do	July 12	52	28	.....	20	17	2	....
U. S. Nat. 96243	Blak. 1555.	ad.	South Yezo	September	53	....	10	.....	.....	.....	....
U. S. Nat. 120441	Henson	ad	Hakodate		.....	.....	10.5	20	.....	.....	....
U. S. Nat. 120442	Henson	ad.	....do		54	....	10	19.5	16	.....	....
U. S. Nat. 120443	Henson	ad.	....do		53	29	10	19	.....	2	....
U. S. Nat. 120444	Henson	ad.	....do		51	28	10	19	17	2	....
U. S. Nat. 114377	Jouy, 1581.	♂ ad.	Fusan, Korea.	Apr. 25, 1886	53	29	10	19	.....	2	95
U. S. Nat. 114376	Jouy, 1505.	♂ ad.	....do	May 3, 1886	54	30	10.5	20	.....	1.5	....
U. S. Nat. 114374	Jouy, 1594.	♂ ad.	....do	May 2, 1886	54	29	10	20	16	1.5	93
U. S. Nat. 114375	Jouy, 1595.	♀ ad.	....do	May 2, 1886	53	30	10	19	16.5	3	93

1374. 1 primary much larger than primary coverts; 2 about = 9; 3 slightly shorter than 4 and 5 which are equal and longest. Tail-feathers subequal.
114376. "Iris very dark brown."

Zosterops japonica TEMM. & SCHL. (180)

♂ and ♀, Nos. 91, 92; Hakodate, March 11, 1883, and January 12, 1885. Normal both in color and size (bills 10.5mm and 11mm). U. S. Nat. Mus. Nos. 120479–80.

It is interesting to note that this delicately looking bird which belongs to a tropical family winters even in Yezo.

Parus hensoni, sp. nov.

♂ ad. Henson, No. 230; Hakodate, November 7, 1884; ♀ ad., No. 231, *ibid.*, October 12, 1884. U. S. Nat. Mus. Nos. 114093 and 120475.

Henson's collection reveals the rather surprising fact that we have at least three forms of Marsh-tits in Japan. When a short time ago I reviewed the Japanese *Paridæ* (Proc. U. S. Nat. Mus., IX, 1886, pp. 378–381) I argued simply from the supposition that there were only two forms to account for, little dreaming that a third one would turn up to complicate this complicated question still further.

The two specimens from Henson agree closely with the Hondo specimens (for which we deem it best at present to retain the name *P. borealis*) in regard to size and proportions, but differ considerably in color, having the top of the head glossy bluish black, like the other Yezo form, which is at once distinguishable by its long and strongly rounded tail. In the review above referred to, I called the Hondo bird *P. brevirostris* with a query, as I had considerable doubt as to the correctness of this identification. This doubt has grown into certainty since

I recently received a specimen from Southern Central Siberia (the habitat of typical *P. brevirostris*) which in every particular agrees with Taczanowski's original description of *P. brevirostris* (Journ. f. Orn., 1872, p. 444), but differs from the Yezo long-tailed birds as much as any two forms of this perplexing group. Both of them have long tails and glossy bluish black caps, but the former is considerably darker, especially below, and has hardly any of the whitish edges to the remiges and outer rectrices so conspicuous in the Yezo birds, and while in these the tail-feathers are regularly graduated, in the Siberian bird all the tail-feathers are nearly equal except the lateral pair, which is much shorter than the rest. There are reasons for believing that had not the name *P. japonicus*, bestowed by Mr. Seebohm upon specimens from Hondo, been preoccupied, it would have been available for the present form. As the case stands now, I shall designate it as *Parus seebohmi* (type, U. S. Nat. Mus., No. 96144), leaving to the future to determine to which other form, if any, it should be linked as a subspecies.

Though differing but slightly from other forms, there is no species or subspecies known to me, which combines the characters as I find them in Henson's two specimens. I will designate it as

Parus hensoni.

DIAGN.: Similar to typical *Parus palustris* (LIN.), but with whitish margins to the tertiaries, and two outer pair of tail-feathers externally edged with white; flanks paler; top of head glossy bluish black; tail doubly rounded, less than 57^{mm}.

HABITAT: Yezo, Japan.

Type: U. S. Nat. Mus., No. 114093, Henson, No. 230; ♂ ad. Hakodate, November 7, 1884.

The three Japanese forms of Marsh Tits (subgenus *Pœcile*) may be distinguished as follows: (cf. "Synopsis" in Pr. U. S. Nat. Mus., IX, 1886, p. 375).*

a^1 Top of head and hind neck dull brownish black ..... *P. borealis.*
a^2 Top of head and hind neck glossy bluish black.
b^1 Tail doubly rounded, less than 57^{mm} ..... *P. hensoni.*
b^2 Tail regularly and strongly rounded, more than 57^{mm} ..... *P. seebohmi.*

It should always be remembered that this "key" does not apply to young specimens before their first autumnal molt, for even the glossy-capped forms have a dull brownish head in the first plumage. The molt takes place in July or August, and in *P. hensoni* and *P. seebohmi* the new feathers on the top of the head are distinctly bluish. Abra-

*I seize the opportunity to correct a lapsus in the "Synopsis" referred to. In a^2b^1, giving the characters of *Parus minor*, the last sentence should read thus: "the *inner* edge being black from the base."

sion, of course, affects the gloss somewhat, but adult birds in corresponding plumage, when compared, are not easily confounded.

Measurements.

Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.	Remarks.
Henson, 230	♂ ad.	Hakodate, Yezo	Nov. 7, 1884	60	54	8	15	14.5	Type.
Henson, 231	♀ ad.	do	Oct. 12, 1884	61	54	8.5	16	14	

Parus ater LIN. (215)

♂ and ♀, Hakodate, October 20, 1884; numbers 236, 237. U. S. Nat. Mus. Nos. 120473–4.

Although some additional material has accumulated since I wrote my previous article on the Japanese Coal Tit (Proc. U. S. Nat. Mus., IX, 1886, pp. 377, 378), I am unable to throw much new light on the subject.

Henson's specimens agree in every respect with those previously at hand from Japan. They have no crest; that is, they have not the feathers on top of the head any longer than European examples (for instance U. S. Nat. Mus., No. 111118, ♂ ad., Christiania, Norway, February 27, 1887, R. Collett, coll.). The tawny tint on the under parts is just a shade deeper in the Japanese birds than in continental European specimens in corresponding plumage before me, but nearly all my Japanese birds are killed in autumn, while most of those from Europe are spring birds. The upper surface is colored identically with specimens from France, Germany, Hungary, and Scandinavia. I stated before (*l. c.*) that Japanese specimens differ from European ones in the black on the hind neck entirely encircling the white nuchal spot and distinctly separating it from the gray of the back. I must confess, however, that this character hardly holds, for in the specimens recently received from Central Europe there are several in which the white is similarly encircled (for instance, U. S. Nat. Mus., Nos. 111394, 111395, 111118), while in Henson's No. 237 the white spot immmediately joins the gray of the back.

I have also remarked that Japanese specimens are smaller than those from the Continent of Europe, agreeing in size closely with *P. britannicus*. The additional material bears out this slight difference, inasmuch as in ten continental European examples the measures of the wing ranges between 59^{mm} (smallest ♀) and 65^{mm} (largest ♂), average 62.3^{mm}, those of the tail between 44^{mm} and 51^{mm}, average 47^{mm}, while six Japanese birds in a similar way vary between 55^{mm} and 59^{mm} (wing), average 58^{mm}, and between 43^{mm} and 46^{mm} (tail), average 44.5^{mm}. Six *P. britannicus* average respectively 58^{mm} and 43.3^{mm}.

Measurements.

Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.
Henson, 236	♂ ad.	Hakodate, Yezo	Oct. 20, 1884	59	46	.....	16	.....
Henson, 237	♀ ad.	.....do	....do	55	43	8	16.5	14

Sitta amurensis SWINH. (222)

♂ ad., Henson, No. 170; Hakodate, October 20, 1884. U. S. Nat. Mus. No. 120478.

Wing, 76mm; tail-feathers, 39mm; exposed culmen, 16mm; tarsus, 18mm; middle toe, with claw, 21mm.

It will be remembered that I established *Sitta amurensis clara* upon some pale-flanked female birds from Yezo (Proc. U. S. Nat. Mus., IX 1886, p. 392). At the same time I remarked that "probably the males will show more of the chestnut color, but judging from analogy I think it safe to say that the amount will be perceptibly less than in the Hondo birds." This will not hold good, and the whole subspecies will have to be dropped, if the male sent by Mr. Henson represents the typical Yezo Nuthatch, for this specimen agrees in every respect with the birds from Hondo. Whether this is really the style of the form *breeding* on Yezo is another question which can not be solved until we receive additional material collected at the various seasons. Having obtained no more typical specimens from Amur I am yet ignorant whether the possible differences of the Japanese birds pointed out by me (*op. cit.*, p. 391) have any significance or not.*

Ægithalos caudatus (LIN.). (220)

Henson's two specimens fully substantiate what I have said on a previous occasion (Pr. U. S. Nat. Mus., IX., 1886, p. 386) in regard to Japanese examples as compared with typical European birds. The measurements are practically identical, and so is the coloration. The bills of the Japanese specimens are the merest trifle longer than in the others. An adult male from Amur agrees closely with the Japan birds, but the vinous of the flanks is a little more vivid, hardly to be distinguished from a Scandinavian specimen (No. 111120).

Seebohm's *Æ. macrurus* seems to me very doubtful. I have only seen a single Siberian specimen (Mus. C. Hart Merriam, Krasnoyarsk, December 31, 1881). It has a tail somewhat in excess of the maximum of *Æ. caudatus* as given in the table below, and the dusky central portion of the tertiaries is very restricted, but the specimen from Pomerania (see table) has even more white on the tertiaries than the Siberian bird.

*I may add that since writing my review of the Japanese Paridæ (*l. c.*) I have received four typical specimens of *Sitta albifrons* from Kamtchatka, thereby verifying my determination of the Kuril specimen (p. 393) as belonging to this form.

The latter measures as follows: Wing, 66mm; tail-feathers, 99mm; bill from nostrils, 4mm.

Measurements.

Museum No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Bill from nostril.	Tarsus.	Middle toe with claw.
U. S. Nat. 56550	Schlüt., 536	♂ ad.	Germany		65	92	4	----	----
U. S. Nat. 95259	do	♂ ad.	Pomerania	Apr. 10, 1876	64	82	4	----	----
U. S. Nat. 111413	Ray	♂ ad.	Saxony	Dec. 15, 1880	63	92	4	17	13
U. S. Nat. 111120	Collett	ad.	Solœr, Norway	Dec. 8, 1886	64	89	4	17	13
U. S. Nat. 96147	Blakist., 3205	♂ ad.	Sapporo, Yezo, Japan	Oct. 23, 1882	61	81	4.5	17	----
U. S. Nat. 91549	Blakist., 3207	ad.	do	do	62	85	4.5	18	13
U. S. Nat. 120476	Henson, 220	♂ ad.	Hakodate, Yezo, Japan	Nov. 3, 1884	65	91	4.7	17	13
U. S. Nat. 120477	Henson, 221	♀ ad.	do	do	63	86	4.5	17	14
U. S. Nat. 111412		♂ ad.	Amur, Eastern Siberia	Mar. 9, 1882	61	88	4	17	12

Regulus * **japonensis** BLAKIST.

♂ ad., No. 171; Hakodate, October 25, 1884. U. S. Nat. Mus. No. 120469.

The name *R. japonicus* seems to have been instituted by Bonaparte in 1856 (Compt. Rend. Ac. Sc., XLII, p. 767), but being unaccompanied by even a trace of a description, or reference to a specimen, description, or plate, it is entirely inadmissible under the existing codes of zoological nomenclature. Bonaparte only says: "Outre le *R. japonicus*, si difficile à distinguer du *R. cristatus* d'Europe," and unless a prior description be found, or a later one, but antedating 1862, Blakiston's *Regulus japonensis* will stand as the first name accompanied by an indication of a distinguishing character.

The Japan Kinglet is easily separable from the European *Regulus regulus* notwithstanding the fact that it is included in the synonymy of the latter, both by Dresser (B. Eur., II, p. 453 (1874)) and Dr. Gadow (Cat. B. Br. Mus., VIII, p. 80 (1883)); Dresser, however, has apparently receded from his former position (*tom. cit.*, p. 451 (1880). The differences between the two forms mentioned have been so well pointed out by Mr. R. Ridgway (Pr. U. S. Nat. Mus., VI, 1883, p. 369), that I need not enlarge upon this subject in the present connection. I may add that their dimensions are nearly identical. As will be seen from the subjoined table of measurements I have before me specimens from all three islands. There seems to be not the slightest difference between them, neither in size, nor in coloration.

* Mr. Oates, in his Birds of India (I, p. 344), gets over the difficulty in disposing of the genus *Regulus* by making it an independent family, *Regulidæ*. He says: "These birds possess a character which suffices to separate them from all the other Passeres, viz, a stiff, small, and perfect feather over each nostril. This character is sufficiently important, in my opinion, to render it desirable to elevate the Goldcrests to the rank of a family." Mr. Oats is evidently not aware that *R. calendula* and *R. obscurus*, which most authors do not even separate generically, have the nostrils hidden by a tuft of small bristle-like feathers. The family character thus fails, but I think the genus *Corthylio* CAB. should stand.

Measurements.

Museum No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.
Christiania N....	Petersen, 42 ..	♂ ad.	Amakusa, Kiusiu ..	Mar. 30, 1786	56	40	8	.....	12
U. S. Nat. 96260 ..	Ringer, 34	*♂ ad	Nagasaki, Kiusiu ..	Nov. 26, 1876	54	41	8	18	.....
U. S. Nat. 109489 .	Namiye.....	♂ ad.	Tokio, Hondo	Jan. 9, 1883	53	39	7	17	12
U. S. Nat. 91359 ..	Jouy, 680	♂ ad.	Tate Yama, Hondo.	Oct. 3, 1882	55	42	7.5	18	.....
U. S. Nat. 91360 ..	Jouy, 695	♂ ad.	.....do.....	Oct. 15, 1882	54	42	7	17	.....
U. S. Nat. 91362 ..	Jouy, 862	♂ ad.	.....do.....	Dec. 9, 1882	55	40	7.5	18	.....
U. S. Nat. 91361 ..	Jouy, 844	♀ ad.	.....do.....	Dec. 5, 1882	53	38	8	17	.....
U. S. Nat. 110486 .	Jouy	♀ ad.	Nikko, Hondo	.....	53	39	8	16	11
U. S. Nat. 96261 ..	Blak., 2560....	♂ ad.	Saporo, Yezo	Apr. 19, 1878	55	41	8	.....	.....
U. S. Nat. 120469 .	Henson, 71....	♂ ad.	Hakodate, Yezo....	Oct. 25, 1884	54	41	8	18	12
Average measurements of 8 males					54	41	7	18	12
Average measurements of 2 females					53	38	8	16.5	11

* Coll. Blakist. No. 2147.

Cinclus pallasii TEMM. (247)

It is extremely doubtful whether the name here employed is the correct one, but inasmuch as it seems impossible at the present time to find out just to which form Temminck originally applied it, we may accept the name in common use, as the original description contains nothing which could seriously affect the identification. Temminck based the name upon a specimen which he received from Pallas at the time when the latter was in the Crimea. For that reason Temminck *conjectured* that the species occurred in that country. The variety which Pallas received from Baical (Zoogr. Ross.-As., I, p. 426) is usually quoted as belonging to *C. pallasii*, but Taczanowski insists (Bull. Soc. Zool. France, 1876, p. 58) that only *C. leucogaster* occurs in that locality. Pallas also states that he received specimens essentially similar from Kamtchatka and the Aleutian Islands through Billing's expedition, but the Dipper does probably not inhabit Kamtchatka, and the species occurring in the Aleutian Islands is *C. mexicanus*. I regard it as very probable that Pallas had no specimens at all of the present species.

Swinhoe's *C. marila* (Ibis, 1860, p. 187) seems to be a smaller race of the present species occurring in Formosa, and a large and more richly colored form is indicated by Mr. Sharpe (*loc. cit.*) as occurring in China.

There is a single specimen in Henson's collection, No. 245, collected at Hakodate, December 12, 1885. It is a female, and, like other specimens from Yezo, it does not differ in any way from birds collected in Hondo. U. S. Nat. Mus. No. 120466.

Hypsipetes amaurotis hensoni, subsp. nov.

DIAGNOSIS: Differs from typical *Hypsipetes amaurotis* (TEMM.) in being paler, the color of the flanks particularly so.

HABITAT: Yezo, Japan, migrating south in winter to Hondo.

TYPE: U. S. Nat. Mus., No. 96280; Blakiston coll.

On a previous occasion (Proc. U. S. Nat. Mus., 1886, p. 642) I made the following observation:

In addition, I should remark that it may later on be expedient to recognize the individuals breeding in Yezo as a distinct race, characterized by the paleness of the flanks and the general lighter tone of the under parts, but at present, with only two specimens from that island, I refrain from naming it. I may also mention that a specimen from Tate-Yama, collected by Jouy October 28, agrees with the Yezo birds. This would not invalidate the status of the latter as a distinct race, since it may be presumed that in winter or during the migrations it may occur in Hondo, especially on the western side. Additional specimens from Yezo are therefore very desirable in order to have the question settled.

Henson's two specimens are consequently of great interest, the more so since I have before me three southern specimens in addition to those enumerated (*tom. cit.*, p. 643).

I find the differences indicated above substantiated in the five additional specimens, and have no hesitation in pronouncing the Yezo birds a good local race, which I take great pleasure in naming after Mr. Harry V. Henson, whose courteous liberality has enabled me to make the present observations.

I append the following measurements:

I.—*Hypsipetes amaurotis.*

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe, with claw.	Total length.
Christiania N....	Petersen, 22 ..	♂ ad	Urakami, Kiusiu ..	Feb. 9, 1886	120	108	22	22	....	....
U. S. Nat., 96279 ..	Ringer, 21	♂ ad	Nagasaki, Kiusiu ..	Jan. 1, 1877	128	115	24	22	23	....
U. S. Nat., 111662 .	Namiye.....	♂ ad	Niishima	Apr. 22, 1887	137	126	24	23	24	280
U. S. Nat., 88664 ..	Jouy, 502	♂ ad	Fuji, Hondo	July 13, 1882	130	119	26	21	23	....
U. S. Nat., 109346 .	Namiye.....	♂ ad	Sagami, Hondo....	Nov. 15, 1884	133	120	24	22	....	....
U. S. Nat., 109347 .	Namiye.....	♀ ad	....do	Nov. 15, 1884	123	112	....	22	22	....
Tokio Educat....	Namiye.....	♀ ad	Napa, Liukiu	Mar. 8, 1886	118	108	24	22	22	265

II.—*Hypsipetes amaurotis hensoni.*

U. S. Nat., 96280 ..	Blakist., 2154..	♂ ad	Hakodate, Yezo ...	Feb. 12, 1877	136	120	....	22	23	....
U. S. Nat. 120481.	Henson, 79....	♂ ad	....do	May 17, 1884	128	120	23	22	24	....
U. S. Nat. 120482.	Henson, 589...	♀ ad	....do	Dec. 9, 1885	130	115	23	22	24	....
U. S. Nat., 96281 ..	Blakist., 2873..	♀ ad	Mororan, Yezo	May 16, 1882	127	112	23	21	22	....
U. S. Nat., 91325 ..	Jouy, 729.....	♀ ad	Tate-Yama, Hondo.	Oct. 28, 1882	127	111	22	23	24	....

Lanius superciliosus LATH. (205)

♂ ad., No. 26, Hakodate, May 16, 1885; ♀ ad., No. 217, August 13, 1883; ♀ hornot. No. 31, May 25, 1885. U. S. Nat. Mus. Nos. 120483–5.

Identical with specimens from Hondo, except that the white frontal band of the adult male is much broader than in an adult male collected by Mr. Jouy on Fuji-yama, Hondo, July 14, 1882 (U. S. Nat. Mus., No. 88672). This specimen is also considerably more tawny on the flanks. Another adult male from Hakodate (Blakiston, No. 2023; U. S. Nat. Mus., No. 96135), collected in June, agrees with Henson's example both in regard to the width of the frontal band and the pale-

ness of the flanks. With only three specimens, however, it is impossible to say whether there is a constant difference between the northern and southern birds or not.

Sturnia violacea (BODD.). (203)

This is the same as Temminck and Schlegel's *Sturnia pyrrhogenys*, of which Henson's collection contains six specimens. Details in table below.

Already Cassin pointed out the great individual variation in the coloration of the adult males (Perry's Jap. Exp., II, p. 220). Capt. Blakiston (Chrysanth., 1882, p. 475) has further enlarged upon this subject as follows:

I secured a good series of examples, showing the variation in the amount of brown, chestnut, or chocolate on the head and neck of the male, from its almost entire absence in the youngest—none, of course, younger than birds born last year—the colored ear coverts, and a few specks on the throat of those of medium age, to the entire side of head, lower part of throat, and slightly round the back of the neck of the most aged specimens. I also noticed that the testicles of all the male birds I opened were nearly black.

Wilh. Blasius (Zeitschr. Ges. Orn., 1886, pp. 123–124) has also some important remarks to the same effect, and the series now before me, consisting of birds collected by the Perry expedition, by Blakiston, Jouy, and Henson, fully substantiates the above statements, though I can not see upon what evidence the above gentlemen consider the birds with but little chestnut for younger individuals and those with very much for very old ones. It may be so, but there is no positive evidence.* This point could be easily settled, however, on young birds far advanced in the molt. Field ornithologists, therefore, should be on the lookout for male birds in August and September with a few feathers of the young plumage left—just sufficient to clearly prove the age—and should be particularly careful in determining the sex with absolute certainty by dissection.

I urge particular care in this instance, as there seems to be some doubt still in regard to the sexual difference in this species and its nearest allies. Mr. A. Hume (Stray Feath., VII, 1878, p. 393) says of the closely allied *Sturnia sturnina* (PALL.) (=*dauurica*) that "in the perfect adult the plumage of the two sexes is quite alike," and in regard to the present species Dr. W. Blasius (Zeitschr. ges. Ornith., III, 1886, pp. 121, 123, and 124) clearly indicates as his belief that the dull brown birds are all young, and that both males and females are essentially alike, the only difference between the sexes being,

*There is, however, one instance on record which, to a certain degree, seems to corroborate the above opinion. Dr. Blasius (*tom. cit.*, pp. 121, 122) describes a winter bird from Celebes (specimen *C*) which is evidently a male in the glossy plumage with only a few brownish feathers of the young dress left. The chestnut ear patch is mixed with white, but judging from the description it has more chestnut color than U. S. Nat. Mus. No. 96124, killed in May.

according to his opinion, the somewhat smaller size and the greater intensity of the rusty suffusion on the white portions of the plumage of the female.* Oates (B. of India, I, 1889, p. 525) also states that "in Sturnia the sexes are alike." From an inspection of the material before me I am led to believe, however, that these gentlemen are mistaken, especially Dr. Blasius (for, though it is highly probable that *sturnina* and *violacea* show no difference in this respect, it is somewhat risky to draw conclusions by analogies in such cases as this), and that Sharpe is correct when describing the two sexes as different (Cat. B. Orn. Mus., XIII, 1890, pp. 70–71).

All the specimens which, in the table below, have the sex mark indicated and not included in parenthesis are thus sexed by the collectors; and all the glossy ones are marked as males, while those which are marked ♀ are all dull brownish. This may be a coincidence, though not very likely, in view of some of the facts to be brought out below; it may also be that some of the collectors have not determined the sex by actual dissection, but then the material tends to show, at least, that the collectors (in this case ornithologists of considerable experience), who were familiar with the birds in their native haunts, regard the glossy individuals as males and the plain ones as females. Three of the brown birds marked as females were collected in May, one as late as the 29th. These differ in several essential points from the young autumnal bird in a somewhat similar plumage. Their bill is quite black, while in the young ones it is horny brown above and quite pale at base of lower mandible. The black bill I take to be an unfailing sign of maturity, and these birds I therefore regard as adult females. Their legs are also darker colored, and in regard to plumage these females differ from the young birds in having the fore neck and breast uniformly grayish white and not streaked with brownish, as in the latter. Somebody might remark that even this is not convincing, and that there is a possibility that the full adult plumage may not be assumed until the molt in the second autumn. But such a supposition is directly disproved by Henson's No. 52. This bird is unquestionably a young bird of the year, which has just commenced its first autumnal molt. The new feathers are just appearing on the lower back, and as they are of a brilliant glossy purple black they prove beyond a shadow of doubt that *the young birds molt into the fully adult plumage already in the first autumn.* It is therefore hardly possible that the brownish winter birds from Celebes which Dr. Blasius examined could be young birds of the

* In justice to Dr. Blasius it should be remarked, however, that he has expressed himself somewhat guardedly. He says (*tom. cit.*, p. 121): "Beide Bälge zeigen in der Färbung und Grösse in die Augen fallende Verschiedenheiten, die wahrscheinlich als Geschlechtsunterschied aufzufassen sein werden, da von einer Verschiedenheit nach der Jahreszeit hier füglich nicht die Rede sein kann" [as both specimens were killed on December 13]. I regard it as well established, however, that the variation in the rusty tinge is partly individual and partly seasonal, and that it has nothing to do with the sex of the bird.

year, and, in fact, the only young bird in the lot seems to be the male in full glossy plumage with but a few feathers left of the brown plumage (specimen *C; tom. cit.*, p. 120).

Henson's No. 113 is perhaps even more convincing and interesting. The former specimen (No. 52) is marked ♂, the present one ♀, and both are, beyond a doubt, young birds of exactly the same age. The female is less brown on the back, the head is grayer, and the streaks on the latter less distinct. New feathers are protruding on the back, as in the male, but these are of a dull drab, while those of the male are metallic purplish black; new whitish feathers also appear on the whole fore neck. It is then plain that the females molt into a dull plumage essentially like that which I take to be that of the adult females (see above) at the same time when the young males molt into the glossy garb of the old males.

So far we have only mentioned the change in the contour feathers of these two specimens. The molt which takes place in the wings is not less instructive, however. As in the true Starling of Europe and in *Acridotheres cinereaceus*, the young *Sturnia violacea* also molts its remiges during the first autumn of its life. If we compare the wings of the glossy old males with those of the supposed adult females mentioned above, we shall find that in the males the outer edges of the inner primaries and of the secondaries, as well as the tertiaries, primary and greater coverts are of a lustrous metallic green, while in the females the metallic gloss is quite subdued and green only on secondaries, primaries, and primary coverts, while greater coverts and tertiaries are brown with a silky shine slightly purplish and hoary in a certain light. The new wing-feathers of the two molting young birds above referred to represent this same difference. The inner primaries and the greater coverts are about half out of their sheaths in the male and are lustrous green; in the female the former and a few primary coverts are also but half out and faintly glossed with green, while the greater coverts are fully out and with a color and gloss as described above in the supposed adult females.

There is consequently strong evidence in favor of a very marked sexual difference both in the adults and in the young birds. But we should be very pleased to receive information from our friends in the field whether they are able to positively confirm or disprove our opinion.

In regard to the specific name here adopted I would remark that Pl. Enlum., No. 185, fig. 2, upon which Boddaert (1783) founded his *Motacilla violacea*, is a rather good representation of the adult male of the bird afterwards described by Wagler as *Pastor ruficollis* and by Temminck and Schlegel as *Lamprotornis pyrrhogenys*. The figure in question is rather extreme in the amount of chestnut on the sides and front of neck, and of gray across the breast, but it is closely approached by No. 96123, U. S. Nat. Mus., which also agrees with Buffon's figure in

having the entire rump glossy purplish black. The same peculiarity is observed in No. 96124, which, however, possesses the minimum of chestnut on the ears.

Measurements.

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.
Tokio Educat....	Nishi	♂ ad.	Yayeyama Isl., Liukiu.	.....	107	51	15	26	26
U. S. Nat., 88693..	Jouy, 590	♂ ad.	Fuji, Hondo.....	July 24, 1882	103	50	.....	24	23
U. S. Nat., 96123..	Blakist., 2849..	♂ ad.	South Yezo	May 21, 1882	113	54	16	26	26
U. S. Nat., 96124..	Blakist., 2850 .	♂ ad.	....do.....	....do	103	53	14	.....	.....
U. S. Nat., 96125..	Blakist., 2855..	♂ ad.	....do.....	May 24, 1882	107	51	15.5	26	25
U. S. Nat., 15863..	Heine, 19.....	♀ ad.	Hakodate, Yezo....	May —, 1854	109	52	14	.....	.....
U. S. Nat., 15862..	Heine, 56.....	♀ ad.	....do.....	....do	106	49	.....	.....	.....
U. S. Nat., 96126..	Blakist., 2856..	♂ ad.	South Yezo	May 24, 1882	105	48	14.5	25	25
U. S. Nat., 120491.	Henson, 23....	♂ juv	Hakodate, Yezo....	Aug. 6, 1883	101	48	14.5	26	26
U. S. Nat., 120492.	Henson, 52....	♂ juv	....do.....	Aug. 14, 1883	107	52	15	26	25
U. S. Nat , 120493.	Henson, 84....	♂ ad.	....do.....	May 30, 1885	108	51	15	25	25
U. S. Nat., 120494.	Henson, 255...	♀ ad.	....do.....	May 29, 1885	105	49	14	25	24
U. S. Nat., 120495.	Henson, 113...	♀ juv	....do.....	Aug. 21, 1883	99	49	14	25	25
U. S. Nat., 120496.	Henson, 19....	juv	....do.....	Aug. 6, 1883	100	47	14.5	24	25

Acridotheres cineraceus (TEMM.). (201)

Three ♀ ♀. No. 111, ad., Hakodate, November 10, 1883; No. 32, ad., Hakodate, June 2, 1883; No. 176, juv., Hakodate, September 11, 1884. U. S. Nat. Mus. Nos. 12048–90.

It is strange that most authors, even those who recognize *Pastor*, *Sturnia*, *Temenuchus*, *Acridotheres*, etc., as distinct genera, or subgenera, should persist in placing the present species in the genus *Sturnus* alongside its type, the European starling, with which, in fact, it has nothing in common that is not shared also by the members of the groups mentioned above. In style of coloration it is as strikingly different from the starling as any, wearing, as it does, the plumage of a typical Hill Myna; its bill is essentially that of *Acridotheres* (though slightly longer than in the typical species), the gently curved culmen, the lateral compression, and the very pronounced notch at the tip of the upper mandible being characters which at once separate it from *Sturnus*, with its straight, flattened, and unnotched beak, while the complete feathering of the nasal groove and the comparatively narrow opening of the nostrils in the former is identical with the corresponding parts in *Acridotheres* as contrasted with the open nostrils and naked operculum of the Starling. The tail is not so rounded as in true *Acridotheres*, but this seems to be the chief difference. I am therefore not prepared to go so far as Mr. Sharpe, who separates this species generically under the name of *Spodiopsar*.

One of Mr. Henson's specimens is of particular interest, viz, No. 176, being a young female in transition from the first plumage to that of the first winter. This specimen is in full molt all over. The new feathers have already supplanted the old ones on lower back and rump; the upper lesser wing-coverts, as well as the greater ones, are also new and fully out, besides a few of the inner primary coverts. But most inter-

esting is the fact that the five inner primaries also are molting, and that the central pair of the new tail-feathers are just emerging from the sheaths, thus proving that the regular molt of the rectrices and remiges *in the first autumn* is not confined to the European Starling. Nor are these two species unique in this respect, for, as has been shown under *Sturnia violacea*, this unusual molt is quite as normal in the latter species.

I have always believed that the Old World *Sturninæ* are closely related to the American *Icterinæ*, notwithstanding the difference in the number of primaries. Mr. Ridgway and I at once set to work examining the large material in the national collection, and found that the young of the American *Icterinæ* molt their quills and tail-feathers during *the first autumnal molt* exactly as do the true starlings. Of course, the material was not sufficient to prove it in every species and genus, but we found it in all cases in the genera *Quiscalus*, *Scolecophagus*, *Agelaius*, *Sturnella*, *Molothrus*, *Dolichonyx*.

This fact seems to add evidence of great importance in support of the opinion that *Icterinæ* and *Sturninæ* are next kin.

Garrulus brandtii EVERSM. (198)

Two specimens, ♂ and ♀ ad.; Henson coll., Nos. 185, 132, Hakodate, September 18 and October 11, 1884; U. S. Nat. Mus., Nos. 120486–7.

English ornithologists assert that they can discover no difference between Japanese specimens and those from Altai, Siberia, whence came the type.

It is curious to note that many authors recognize the present form as a distinct species while treating of *G. japonicus* as a mere geographical variety of *G. glandarius*. True, the latter are quite similar in the general coloration, but the loral region, the primaries, and the tertiaries are quite differently colored without any trace of intergradation or variation. In all these points *G. brandtii* agrees with *G. glandarius*, the chief difference between them consisting in the strong wash of cinnamon-rufous, which suffuses the head in *G. brandtii*. In eastern Russia, moreover, there seems to exist a somewhat intermediate form, *G. severzowi* BOGDAN.

Pyrrhula griseiventris LAFR. (296)

Nos. 242, ♂ ad., Hakodate, November 25, 1883; No. 243, ♀ ad., Hakodate, November 20, 1884; U. S. Nat. Mus., Nos. 120497–8.

Being winter specimens, this pair does not add much towards finally settling the status of *P. rosacea*. The male is quite typical of the latter phase, being nearly identical with No. 3 of my list (U. S. Nat. Mus., 1887, p. 107), from Kiusiu.*

* Sharpe, in his Cat. B. Brit. Mus., XII, p. 832, enumerates three *P. rosacea*, two males and one female, as collected by C. McVean in "Yezo." This is evidently a mistake which is repeated in all the birds enumerated as coming from the same source. The locality in each case should be "Yedo," the former name of Tokio, and the birds consequently came from the middle island and not from Yezo.

The female is the first Yezo specimen of that sex which I have had an opportunity to examine. It differs in no way from specimens from the other two islands.

Uragus sanguinolentus (TEMM. and SCHL.). (289)

A female collected at Hakodate, November 9, 1883, and a male collected six days later are in the collection (Nos. 115 and 114; U. S. Nat. Mus., Nos. 120500 and 120499). They agree with other specimens before me in every particular.

Acanthis linaria holboellii (BREHM). (286–7)

I have stated on several occasions (Auk, 1887, pp. 33–35, and Proc. U. S. Nat. Mus., XIV, 1891, p. 487) that the only subspecies of Red-poll belonging to the Japanese fauna is the long-billed coast form, named as above.* Henson's specimen (No. 241; U. S. Nat. Mus., No. 120501), which was collected at Hakodate, March 27, 1883, belongs eminently to this form. It is a male, without red on throat and breast, measuring as follows:

Wing, 75^{mm}; bill, from nostril, 9^{mm}. All the tail-feathers are molting and still in their sheaths.

Leucosticte brunneonucha (BRANDT). (288)

A pair was collected by Henson near Hakodate in November, 1885 (Henson, Nos. 87, 88; U. S. Nat. Mus., Nos. 120501–2), agreeing in every respect with other winter birds from Yezo and from Hondo, fourteen specimens of which are now before me. A comparison of these with five from Kamtchatka, and four from Ussuri, on the mainland, show no perceptible differences.

There is no record of this species having been observed in Japan proper during the breeding season, all the specimens hitherto obtained having been collected during the winter months, if we except a single specimen ♂ (No. 1951), shot by Capt. Blakiston at Hakodate, on May 5, 1876. On the other hand, it has repeatedly been found in summer on the Kurile Islands. However, it may confidently be looked for during the breeding season along the seashore of Yezo, where there must be plenty of wild and precipitous rocks to suit the taste of these birds.

During the summer the brown on the nape wears off and this part becomes a silvery white, more or less shaded with buff. The light

*At the same time I was careful to remark that "it is reasonable to expect that both *A. linaria* and *exilipes* in winter may visit the northern island." Since that was written Mr. Sharpe, in his Cat. B, Brit. Mus., XII, p. 249, refers two specimens from "Japan" to typical *A. linaria*, with a wing 2.75 inches long, and in the synonymy he refers Blak. and Pryer's No. 287 to this form. The identification of the specimens in question is probably correct, but the quotation certainly refers to *A. holboellii*, as I have already shown. This remark refers also to Sharpe's quotation of Blak. & Pryer's 286 under *A. exilipes*.

edges to the dorsal feathers also wear off and the whole upper surface consequently looks darker than in winter, features nicely illustrated by a fine ♂, with black bill, collected in Ussuri, March 27, 1881 (U. S. Nat. Mus., No. 111358). The gray nape of this bird explains the corresponding portion of Pallas's description of the "variety β 1." from the Kurile Islands, "*vertice* nigricante; *cervice* cano-albido." The absence of rosy color, which in Pallas's bird seems to be replaced by cinnamon, is not so easily accounted for, though I have before me a specimen from Kamtchatka (U. S. Nat. Mus., No. 21126, Wm. Stimpson's coll.) which, in every respect, agrees with Pallas's description, but this bird has apparently originally been preserved in alcohol, which seems to have extracted the rosy color. The fact that the nape of *L. brunneonucha* becomes gray in summer may possibly have misled Prof. Lichtenstein to determine two birds in the Berlin Museum said to have come from the Kurile Islands as *L. grisconucha* (Nomencl. Av. Mus. Berol., 1854, p. 47), though "Kurile Islands" may be a lapsus for "Aleutian Islands." At any rate, *L. grisconucha* does not occur in the former.

Chloris kawarahiba (TEMM.). (283)

Two specimens of the larger Japanese Green Finch, viz, Nos. 224 and 225, ♂ and ♀, Hakodate, November 11 and October 18, 1883 (U. S. Nat. Mus., Nos. 120506–7). For dimensions, etc., see the following species.

Chloris kawarahiba minor (TEMM. and SCHLEG.). (284)

The Eastern Green Finches are still in a state of confusion, and though having quite a number of specimens before me I have not been able to solve *all* the questions or clear *all* the doubts. I have satisfied myself as to the correctness of a few conclusions, which differ somewhat from the opinion generally accepted.

In the first place the smaller Japanese Green Finch is not identical with the Chinese *Chloris sinica* (LIN.). They agree in size, but differ considerably in coloration. In the last-mentioned bird there is very little, if any green in the yellow that spreads over the under surface from the chest backward. On the contrary, the yellow is strongly suffused with a tawny brown. In *Ch. sinica*, furthermore, the great upper wing-coverts are brown, while in *Ch. kawarahiba minor* they are olive-green, more or less suffused with yellow; and, finally, in the Chinese bird the pale margins to the inner secondaries and the tertiaries are considerably wider than in the *smaller* Japanese form. Whether specifically or only subspecifically distinct is impossible for me to say at present, but this question is comparatively unimportant. The essential thing at the present stage is the fact that the two forms *are separable.*

Strange to say, although the smaller Japanese form is almost universally called *Ch. sinica*, and nearly all authors admit the distinctness of a smaller and a larger species in Japan proper, the two latter forms are much more difficult to separate and are much more closely allied.

In fact, I was long in doubt whether they could be separated at all, and still more so as to where to draw the line.

The two Japanese forms were originally separated by Schlegel in Fauna Japonica, the characters ascribed to them being the smaller size and the deeper and brighter colors of *Ch. kawarahiba minor*. Sharpe (Cat. B. Br. Mus., XII, pp. 26–28), who accepts Swinhoe's identification of the latter with *Ch. sinica*, gives the same characteristic of the two forms which he regards as species. Schlegel gives the following dimensions of the wing: *kawarahiba major*, 90^{mm}; *k. minor*, 77^{mm} to 81^{mm}. Sharpe's measurements are respectively: 86^{mm} to 89^{mm} and 76^{mm} to 85^{mm}, the larger dimensions being in every instance that of the male, the smaller that of the female. Whitely (Ibis, 1867, p. 202) gives also some measurements, viz, 82.5^{mm} and 89^{mm}, the latter being, however, that of a female bird only. Thus these authors allow a gap of about 10^{mm} between the males of the two forms. Capt. Blakiston, however, has already shown that there is no such gap (Chrysanth., 1882, p. 474), and a glance at the tables below shows conclusively that they run into each other as far as size expressed by length of wing is concerned.

According to the authors quoted above, the smaller size is accompanied by deeper and brighter colors. A glance at my series would convince any one that this does not hold good. My Kamtchatkan* male, one of the largest, is quite as brightly colored as any one in the whole collection.

Capt. Blakiston (*loc. cit.*) has called attention to the greater size of the bill of *Ch. kawarahiba* as a more reliable character than the length of body or wing; but even in this respect no hard and fast line can be drawn. There is a regular gradation between the heaviest and longest bills to the shortest and most slender, and it will be seen that generally the bigger bill is associated with the longest wing. Size of bill, therefore, is no more absolute character than length of wing.

An inspection of my series, however, convinces me that there is a character which, taken in conjunction with those of size, makes it possible to distinguish in most cases between the two forms, for I find that the larger birds have the secondaries and tertiaries, particularly the former, much more broadly edged with light than the smaller specimens, in which, moreover, the edges are grayer, while in the former they are nearly pure white. This character is most beautifully illustrated in the two breeding females, No. 88680, from Fiji, Hondo, and No. 92626, from Petropaulski, Kamtchatka, for although the latter is in a more abraded plumage than the former, the pure white edges to the secondaries form a very conspicuous white longitudinal bar on the folded wing; in the former there is hardly a trace of light edges.

This, fortunately, gives us a fixed basis for determining the range of the two forms. Defining, as I do, *Chloris kawarahiba* as the larger form

* The Kamtchatkan habitat of *Ch. kawarahiba* and the reference to this species in my "Results of Ornithol. Explorations in Kamtschatka, etc.," have been entirely overlooked by Sharpe (*loc. cit.*).

with the broader white edges to the secondaries, we have now ascertained that it breeds in Kamtchatka; and as the smaller form has not at all been found in that country, it is safe to assume that this peninsula is its home *par excellence*. On the other hand, it is certain that the smaller form, with the edges to the secondaries narrower and grayer, *Chloris kawarahiba minor*,* breeds in the middle island of Japan. That it also breeds in Yezo is probable from the fact that Henson's specimen No. 226 was taken at Hakodate on May 10, and seems also to be indicated by Whitely.

The larger form is migratory in Kamtchatka. It has never been taken on the mainland of Asia. Consequently, it is pretty safe to conclude that its only way of migration is to Japan in winter, where it is found numerous all through the cold season as far south as Nagasaki. It may breed in Yezo and in the mountains of northern Hondo, but we have no evidence of it, and, on the whole, I think it rather improbable.

The results of this investigation consequently indicate that there are two separable forms, *Ch. kawarahiba*, inhabiting Kamtchatka in summer, migrating south to southern Japan in winter, though occasionally wintering as far north as Hakodate, and *Ch. k. minor*, a resident of Japan, which is stationary at least in the southern provinces of that empire. *Ch. sinica* does not occur in Japan at all.

I.—*Measurements of Chloris kawarahiba.*

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.
U. S. Nat., 89017	Stejn., 1205	♂ ad.	Between Bering I. and Kamtchatka.	June 13, 1882	88	53	12	....	.....
U. S. Nat., 92626	Stejn., 2302	(♀) ad.	Petropaulski, Kam.	July —, 1883	88	55	12	....	.....
U. S. Nat., 96360	Blak., 1587	♂ ad.	Hakodate, Yezo	Apr. —, ——	82	50	12	17	.....
U. S. Nat., 96365	Blak., 2842	♂ ad.	Nikap, Yezo	May —, ——	86	55	12	18	20
U. S. Nat., 91542	Blak., 3210	(♂)	Sapporo, Yezo	Oct. —, ——	84	54	11	....	.....
U. S. Nat., 96369	Blak., 3202	(♂)	....do	Oct. —, ——	85	57	11	....	.....
U. S. Nat., 96368	Blak., 3073	juv.	....do	Oct. —, ——	81	50	11.5	....	.....
U. S. Nat., 96366	Blak., 2843	♀	Nikap, Yezo	May —, ——	84	52	12	....	.....
U. S. Nat., 96362	Owst., 390	(♂)	Yokohama, Hondo	.....	83	53	12	....	.....
Christiania	Peters., 41	♂ ad.	Tokitsu, Kiusiu	Mar. 29, 1886	85	52	11.5	....	.....
Christiania	Peters., 29	♂ ad.	Urakami, Kiusiu	Feb. 15, 1886	85	55	11.5	....	.....
Christiania	Peters., 98	♀ ad.	Nagasaki, Kiusiu	Dec. —, 1886	84	51	12	....	.....
U. S. Nat., 120506	Henson, 224	♂	Hakodate, Yezo	Nov. 11, 1883	88	55	13	19	20
U. S. Nat., 120507	Henson, 225	♀	....do	Oct. 18, 1883	84	53	12	....	.....
Average measurements of 14 specimens					85	53	11.8	....	.....

* I should state here that the distinction between the two forms here pointed out is very well shown in the beautiful plates of these birds in Fauna Japonica (Aves, pls. xlviii and xlix), though not mentioned in the text.

II.—*Measurements of Chloris k. minor.*

U. S. Nat. Mus. No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.	Remarks.
96367	Blak., 3070 ..	♂	Sapporo, Yezo ...	Oct. —, ——	81	....	11	.....	.....	Molting.
96359	Blak., 1158 ..	(♂)	Hakodate, Yezo..	Mar. —, ——	83	52	11.5	.....	.....	
96364	Blak., 1264 ..	♀ ad.	....do	May —, ——	80	52	11	.....	.....	
88680	Jouy, 506 ...	♀ ad.	Fuji, Hondo	July 13, 1883	78	53	10	.....	.....	
91489	Jouy, 938 ...	♂	Yokohama, Hondo	Jan. 10, 1883	79	49	11	16.5	.....	
85784	Jouy, 10	♂ ad.	Yokoska, Hondo .	May 10, 1881	79	51	11	.....	.....	
85785	Jouy, 12	♀ ad.	....do	May —, ——	75	49	10.5	.....	.....	
96363	Owst., 408...	(♂)	Yokohama, Hondo	.....	82	53	11	.....	.....	
96361	Ringer, 38 ..	♂	Nagasaki, Kiusiu	Dec. 17, 1876	79	50	10.5	.....	.....	
114738	Ringer, 30 ..	♂	Aso-yama, Kiusiu	Jan. —, 1887	79	51	11	.....	.....	
120504	Henson, 226.	♂	Hakodate, Yezo..	May 10, 1886	80	51	11	17.5	18	
120505	Henson, 227.	♀	....do	Oct. 22, 1884	80	50	11	.....	.....	
Average measurements of 12 specimens					80	51	10.9	.....	.....	

Coccothraustes coccothraustes japonica (TEMM. AND SCHL.). (292)

A pair. For particulars see "measurements" given below.

The Hawfinch is one of the few birds which do not follow the rule that the representative forms in Japan are brighter and purer colored than the corresponding forms in Europe, for in the series of twenty-four birds before me it is easy enough to pick out the European specimens from those of eastern Asia by their brighter general coloration, with the exception of one (♂, U. S. Nat. Mus., No. 102932, Vosges, France, January, 1877, Mougel coll.), which can hardly be told apart from some Japanese specimens by color alone. True, Mr. R. B. Sharpe (Cat. B. Br. Mus., XII, p. 40) gives as a distinguishing character between the two forms, that in *C. japonica* the wing coverts are "ashy whitish or pale drab at the ends instead of whitish" in the typical western form, but this character does not hold at all, as two European males, the one referred to above and No. 114695 (Talamone, Italy, April, 1880), have these light tips quite as dingy as in the average Japanese bird, while one of the latter (♂, U. S. Nat. Mus., No. 109372, Suruga, Hondo, November 21, 1884, Namiye coll.) has them purer white than any of the European examples at hand. And as with the males so with the females, some are indistinguishable by color alone, while in these also the European birds are, on the whole, somewhat brighter colored.

There is one character, however, which seems to hold when others fail, viz, the greater height and bulk of the bill of typical *C. coccothraustes*. As will be seen from the tables of measurements given below, the two forms are identical in general size,* but the bills of the European birds are considerably larger. The lower mandible is particularly strong, as shown by the measurements which are taken on the side of the mandible at the base where the feathers join the horny sheath.

* The males are slightly larger than the females. The measurements of the Japanese form given by Sharpe (*loc. cit.*) are therefore misleading.

On the whole the two forms are fairly separable, and as the eastern subspecies was originally described under a trinominal appellation, I see no reason for changing it into a binominal.

A male specimen collected by Mr. Jouy at Matsumoto, Hondo (No. 91437, November 5, 1882), is very remarkable for its unusually dark and saturated coloration. The back is a dark blackish brown, still blacker on the scapulars, while the tertials are wholly black, with a delicate green silky gloss; the longest of the upper tail-coverts are of a deep burnt umber. It looks so different from all the other specimens, eastern and western, that at first I was tempted to regard it as a special form, but I am now convinced that it is only a case of excessive individual variation.

I.—*Measurements of Coccothraustes coccothraustes japonica.*

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe with claw.	Total length.	Height of lower mandible at base.
U. S. Nat., 109372	Namiye	♂ ad.	Suruga, Hondo.	Nov. 21, '84	100	55	19	15	....	....	....	4.8
U. S. Nat., 91568	Jouy, 1023	♂ ad.	Yokohama, Hondo.	Mar. 26, '83	100	54	19	14	22	24	....	4.5
U. S. Nat., 91437	Jouy, 769	♂ ad.	Matsumoto, Hondo.	Nov. 5, '82	105	52	18	15	22	23	....	4.8
U. S. Nat., 96382	Blak., 1046	♂ ad.	Hakodate, Yezo.	Jan. 5, '73	103	54	19	15	22	....	7 in.	4.5
U. S. Nat., 120508	Henson, 222	♂ ad.	Hakodate, Yezo.	Nov. 22, '84	99	54	19	....	....	....	....	4.5
Christiania	Petersen, 48	♂ ad.	Tokitsu, Kiusiu.	Apr. 16, '86	104	58	20	15	....	....	....	4.8
Do	Petersen, 118	(♂)ad	Kiusiu	.....	100	55	19	15	....	....	....	4.5
U. S. Nat., 96383	Blak., 3148	♂juv.	Sapporo, Yezo.	Oct. 14, '82	99	54	17	13	22	22	180	....
U. S. Nat., 91527	Jouy, 976	♀ ad.	Yokohama, Hondo.	Mar. 1, '83	101	51	17	14	22	24	....	4.0
U. S. Nat., 91438	Jouy, 857	♀ ad.	Tate Yama, Hondo.	Dec. 9, '82	100	....	19	14	22	24	....	4.8
U. S. Nat., 96384	Blak., 3199	♀ ad.	Sapporo, Yezo.	Oct. 19, '82	102	53	18	14	22	24	174	4.0
U. S. Nat., 120509	Henson, 223	♀ ad.	Hakodate, Yezo.	Nov. 20, '84	102	53	18	....	....	....	....	4.5
Average measurements of 7 adult males					102	54	19	15	....	....	....	4.6
Average measurements of 4 adult females					101	52	18	14	....	....	....	4.3

II.—*Measurements of Coccothraustes coccothraustes.*

U. S. Nat. Mus. No.	Collector and No.	Sex and age.	Locality.	Date.	Wing.	Tail-feathers.	Exposed culmen.	Height of bill at base.	Tarsus.	Middle toe with claws.	Height of lower mandible at base.
56657	Schlüter, 776	♂ ad.	Germany	.....	106	56	20	17	....	....	5.5
18597	Mus. Cop. enh.	♂ ad.	Denmark	Feb. 24, ——	105	56	20	17	22	....	6.0
113771	Gätke	♂ ad.	Heligoland	May, 1887	100	54	19	16	....	....	6.0
102932	Mougel	♂ ad.	Vosges, France	Jan., 1887	103	55	20	17	....	....	5.8
114695	——, 2770	♂ ad.	Talamone, Italy	April, 1880	105	57	21	16	....	....	6.0
69970	Soph. Burch	♀ ad.	Rostock, Germ'y	.....	100	53	19	15.5	21	22	5.0
13051	Drexler	♀ ad.	Germany	.....	102	53	....	15	....	....	5.0
17007	Drouet	♀ ad.	France ?	.....	102	53	19	15	21.5	22	5.0
102931	Mougel	♀ ad.	Vosges, France	Mar., 1877	100	55	20	17	....	....	5.0
Average measurements of 5 adult males					104	56	20	16.6	....	....	5.9
Average measurements of 4 adult females					101	54	19.3	15.6	....	....	5.0

WING-FEATHERS OF MOTACILLA LUGENS; NATURAL SIZE.

Fig. 1. Secondary next to longest tertiary (juv., U. S. National Museum, No. 96208; Yezo; July; Blakiston collection, No. 1561).

Fig. 2. Secondary next to longest tertiary (♀ after molt, second autumn; U. S. National Museum, No. 96205; Yezo; September; Blakiston collection, No. 2959).

Fig. 3. Fifth primary of same.

Fig. 4. Secondary next to longest tertiary (♂ after molt, second autumn; U. S. National Museum, No. 96209; Yezo; September; Blakiston collection, No. 2957).

Fig. 5. Fifth primary of same.

Fig. 6. *a*, left wing; *b*, right wing; fifth primary (U. S. National Museum, No. 96197; Yezo; March; Blakiston collection, No. 1154.)

INSECTS OF THE SUBFAMILY ENCYRTINÆ WITH BRANCHED ANTENNÆ.

BY
L. O. HOWARD.

(With Plates XLVI–XLVII.)

In a paper entitled "A new and remarkable Encyrtid," published in 1890 (Insect Life, vol. III, pp. 145–148), I showed that up to 1889 Westwood's single specimen of *Tetracnemus diversicornis*, captured in 1835, was the only acknowledged encyrtine with branched antennæ ever found. It is true that in 1885 Mr. Ashmead had described his *Tetracnemus floridanus*, but he had placed it in the subfamily Eulophinæ, not recognizing its encyrtine affinities. In 1889, however (Proc. Entom. Soc., Washington, I, 503), Mr. Ashmead announced that his species was a true encyrtine, and since that recent date five additional species, belonging to four new genera, have been found, while *Tetracnemus floridanus* has been shown to belong to still another new genus, making five in all. It is the purpose of this paper to describe the new forms and to bring the groups together to facilitate the characterization of additional genera and species which I feel sure will be discovered in the near future.

Although the forms to be described in this paper agree in the abnormal branching of the antennæ of the male sex, they can not be said to form a natural group. *Tetracladia*, *Calocerinus* and probably *Tetracnemus* seem closely allied, and, were tribal divisions necessary in the subfamily, these three genera would be grouped together. *Hexacladia*, *Tanaostigma*, and *Pentacnemus*, however, all of which we fortunately know in both sexes, differ widely from the other three genera. *Pentacnemus* would plainly belong near *Copidosoma* in any natural arrangement of the known genera, but *Hexacladia* and *Tanaostigma* introduce new features into the encyrtine system and would form tribes by themselves. There exists, however, in the National Museum collection a new genus, reared in large series by Messrs. Coquillett and Koebele in California from a gall on mesquit, which plainly possesses strong affinities with *Tanaostigma*, but of which unfortunately we know only the female sex. The male may prove to have branched antennæ.

With this understanding of the diversity of the forms, the use of a purely provisional tribal name, *Tetracnemini*, may not be objected to. For the present it may include all Encyrtinæ whose males have branched

antennæ, but may later be restricted to *Tetracnemus*, *Tetracladia*, *Calocerinus*, and allied forms.

The host relations of these insects may prove as variable as their structure. As yet we know with certainty the habits of but one—*Pentacnemus bucculatricis*—which was reared in large numbers from the overwintered cocoons of *Bucculatrix thujella* Pack., which had been sent to Dr. Riley from Cadet, Washington County, Mo., by Mr. J. G. Barlow. All of the specimens of *Tanaostigma coursetiæ* were extracted from the swollen ovaries of dry herbarium specimens of *Willardia mexicana*, a rare legimunous plant, which was supposed to belong to the genus *Coursetia* at the time the description was drawn up, but which was subsequently made the type of the new genus *Willardia*. The most careful dissection shows no trace of any insect other than the *Tanaostigma*, but as we can not but suppose that this insect is parasitic, the swollen ovaries must have originally been damaged by some other insect, perhaps by some small rhyncophorus beetle. The other five species were all captured, *Tetracnemus diversicornis* on oak, *Tetracladia texana* by sweeping grass, and *Calocerinus floridanus* upon oak. Concerning *Hexacladia smithii* and *Tetracladia gracilis* we have no further information than that they were collected, the former at Chapada, Brazil, by Mr. H. H. Smith, and the latter at Jacksonville, Fla., by Mr. Ashmead.

The genera may be separated by the following artificial key:

Provisional tribe Tetracnemini.

MALES.

Antennæ with four branches.
  Mesoscutum with a transverse oblique impressed line ..... *Tanaostigma* How.
  Mesoscutum normal.
    Scapulæ widely separated at tips; antennæ 10-jointed ..... *Tetracnemus* Westw.
    Scapulæ meeting at tips; antennæ 11-jointed.
      Sixth funicle-joint of the antennæ more than twice as long as the other five together ..... *Calocerinus* n. g.
      Sixth funicle-joint shorter than fifth ..... *Tetracladia* n. g.
Antennæ with five branches ..... *Pentacnemus* n. g.
Antennæ with six branches ..... *Hexacladia* Ashm.

FEMALES.

Antennal scape with a leaf-like expansion below ..... *Tanaostigma* How.
Antennal scape subcylindrical.
  Antennæ arising at clypeal margin ..... *Pentacnemus* n. g.
  Antennæ arising from above clypeus ..... *Hexacladia* Ashm.

TETRACNEMUS Westwood.

Westwood's original description of this genus and its single species was published in Magazine of Natural History, 1837, Vol. I, new series, pp. 257–259, under the title "A new genus of British parasitic Hymenoptera," and is here copied:

"Genus quasi intermedium inter *Encyrtum* et *Eulophum*. *Corpus*

oblongam, minutum. *Caput* thorace paullo angustius. *Ocelli* distantes *Antennæ* capite cum thorace longiores; 8-articulatæ; articulo 1mo, elongato; 2do, parvo, obconico; 3tio, 4to, et 5to, minimis, singulo ramum elongatum supra emittenti; 6to longo, tenui, apice supra ramum emittenti; 7mo, paullo breviori; ultimo, magno, oblongo-ovato. *Thorax* ut in Encyrtis formatus, *scutello* magno subrotundato. *Alæ* anticæ nervo subcostali, cum costa spatio parvo conjuncto, et ad apicem ramum parvum clavatum et curvatum emittente. *Pedes* sat longi atque graciles, intermedii ut in Encyrto formati. *Tarsi* 5-articulati pulvillo magno. *Abdomen* parvum, ovatum, subdepressum; apice subacuminatum. Mas.

"Species unica mihi adhuc cognita.

"*Tetrachemus diversicornis* Westw.

"*Caput* nigro-æneum, vertico tenuissime et transverse rugosum. *Antennæ* nigræ, pilosæ. *Thorax* æneus, scabriculus; *tegulæ* piceæ. *Abdomen* nigricans. *Pedes* nigricantes, geniculis rufescentibus, tarsis piceis, calcaribus et articulo basali pedum intermediorum, luteis. Long corp. $\frac{1}{2}$ lin.; expans. alar. 1 lin. Habitat in quercetis apud Sylvam Coombe, die 3tio Julii, 1835, captus."

TANAOSTIGMA Howard.

The following description of this genus and its sole species is copied from Insect Life, Vol. III, No. 4, November, 1890, pp. 147–149:

"*Male.*—Resembles somewhat closely *Tetracnemus* Westwood. Antennæ 11-jointed+2 ring-joints; scape with a slight expansion below, *the expansion faintly serrate;* pedicel one-third as long as scape, narrowed at base; joints 1, 2, 3, and 4 of the funicle (not counting ring-joints) each with a single long hairy dorsal apical ramus, each ramus bent forward and reaching to base of club; joints 1 and 2 short, subequal in length, and considerably broader than long; joint 3 one-third longer than 2; *joint 4 rather more than twice as long as 3; joint 5 rather more than three times as long as 4, gradually widening towards tip; joint 6 a little longer than 4, gradually widening from 5;* club oval, somewhat flattened, twice as long as joint 6 of the funicle and slightly wider, *joints plain.* Face sunken in and shriveled in death; *ocelli forming a straight line. Mesocutum with a faint transverse, slightly oblique impressed line just anterior to and almost parallel with the scuto-scapular furrow, and connected with this by a faint median longitudinal impressed line; scapulæ just meeting at tip, the mesoscutellum therefore pointed anteriorly,* rounded posteriorly. Wings hyaline, not ciliate; marginal vein long; postmarginal less than one-third as long as marginal; *stigmal a trifle more than twice as long as postmarginal and descending almost vertically into the wing,* the club bending abruptly outwards. Abdomen very short, *almost truncate behind.* Middle tarsi short, *two-thirds the length of the short tibiæ;* mesotibial spur rather slender for this group, but longer than the first tarsal joint and acutely pointed.

"*Female.*—Antennæ with the same number of joints as in the male; scape with a rather broad, leaf-like expansion below; pedicel short and rounded; flagellum broad, flattened, slightly clavate, the joints of the funicle all broader than long, convex basally, concave apically, gradually increasing in length and width from 1 to 6; club as long as the first four funicle joints together. Face short; cheeks scarcely rounded; antennal grooves very sharp; ocelli in a straight line or the middle one is very slightly anterior to the lateral ones. Thoracic and wing characters as in male. Abdomen punctate, turned upward at tip; ovipositor slightly extruded and pointed upward.

Tanaostigma coursetiæ Howard.

"*Female.*—Length 1.8^{mm}; expanse 4^{mm}; greatest width of fore wing 0.64^{mm}. Head, face, thorax, and abdomen finely, closely, and evenly punctured. General color blue-black; palpi white; a narrow black band above mouth; just above this a broad yellow-white band extending across the face around the base of the eyes to a short distance behind the genæ; above this a narrow black transverse band from eye to eye at base of antennæ; above this a yellow-white band of about the same width, from eye to eye; antennal groove yellow-white; a light-yellowish spot behind the eyes and above the first-mentioned yellow band, and a narrow line of the same color across occipital margin between the eyes; propleura and mesopleura edged above and in front by a narrow yellowish band; antennæ black; front coxæ edged with yellowish-white; other coxæ and all femora and tibiæ black, lighter at joints; front tarsi dusky; middle tarsi yellow-white; hind tarsi yellow-white; last joint black, first joint dusky at base. Thorax and abdomen with sparse silvery scale-like pubescence, easily rubbed off.

"*Male.*—Length 1.4^{mm}; expanse 3.2^{mm}; greatest width of fore wing 0.62^{mm}. General color uniform metallic blue-black. Head, thorax, and abdomen very faintly shagreened, shining, almost smooth. Coloration of legs as in female.

"Described from 3 ♀, 9 ♂ specimens, all more or less mutilated, taken from ovaries of *Coursetia* (*?*) *mexicana* collected in the Alamos Mountains, Mexico, by Dr. Edward Palmer."

HEXACLADIA Ashmead.

The following descriptions of this genus and its sole species are copied from Insect Life, Vol. III, Nos. 11 and 12, August, 1891, pp. 456–457:

"Head very broadly transverse, including the eyes, much wider than the thorax, the face full convex, the space between the eyes and the mandibles longer than the length of the eye. Eye broadly oval, bare. Ocelli three, rather close together and subtriangularly arranged. Labrum very small, transverse, twice as wide as long. Mandibles very small, oblong, truncate at tips, bidentate. Maxillary palpi rather long, five-jointed; labiales short, three-jointed. Antennæ in both sexes

eleven-jointed, inserted on the middle of the face, the scape long, cylindrical, projected far above the vertex; in the male the six funicle joints each furnished with a long hairy ramus, the basal one being the longest, the others gradually diminishing in length to the last; the first funicle joint is very short, the following all long, at least thrice longer than the first; club long, fusiform, three-jointed. In the female the flagellum is subclavate, the first funicle joint being remarkably long, almost as long as the five following joints together; the last five funicles are short and very gradually increase in length and width to the club, the latter composed of three joints. The thorax in the male is strongly developed, highly convex, resembling somewhat an Eucharid; in the female less strongly developed. Mesonotum transverse, smooth, polished, without trace of furrows. Scutellum longer than wide, rounded behind and highly convex. Axillæ transverse, convex. Metathorax short, smooth, the spiracles very large, rounded. Middle legs slightly the longest, their tibiæ long, slender, cylindric, about one-third longer than the tarsi, the spur more than half the length of the basal tarsal joint, the tarsi stouter than the posterior tarsi, the joints after the first very short. The posterior femora and tibiæ are slightly dilated, the tarsi slender, cylindrical, and almost as long as the tibiæ.

"Abdomen, in both sexes, is small in proportion to the thorax; in the male it is long, oval, composed of seven segments, the first much the longest, the others short, all of about an equal length; in the female it is subcompressed, composed of six segments, the hypopygium being plowshare shaped, the ovipositor slightly exserted; as in the male, the first segment is the longest.

"Wings banded; the submarginal attains to the middle of the wing before jointing the costa, the costal cell being somewhat wide; the marginal vein is thickened and a little longer than the stigmal; the stigmal clavate curved upwards; the postmarginal is longer in the male than in the female."

Hexacladia smithii Ashmead.

"*Male.*—Length, 1.8^{mm}; wing expanse, 4^{mm}. Head brownish-yellow, smooth, polished, the vertex fuscous; face very convex, with a few scattered, shallow punctures. Eyes broadly oval, brown. Antennæ black, the scape pale rufous, with a dusky streak above, the six funiclar joints each furnished with a long hairy branch. Thorax black, impunctured, highly polished; collar brownish-yellow; scutellum shining, but microscopically shagreened. Anterior legs, including coxæ, brownish-yellow; middle and posterior legs black; in the middle pair the knees, tips of tibiæ, tibial spur, and tarsi are brownish-yellow. Abdomen black, the dorsum concave, probably unnaturally so in the dry specimen. Wings hyaline, with two transverse brown bands that do not extend entirely across the wing, terminating at about its center; the first and narrower is situated at about two-thirds the length

of the subcostal vein, the second and broader one just beneath the marginal.

"*Female.*—Length, 2mm. Head much wider than in the male, and except a streak on the face below the base of the antennæ, entirely black. Antennæ subclavate, brown, the scape and pedicel rufous. Thorax above black, highly polished; the basal half of the scutellum is bright red; collar, mesopleura, anterior legs, middle coxæ, tips of middle and posterior tibiæ, and their tarsi, rufous; the rest of the legs dark fuscous. Abdomen short, rather strongly compressed, black, shining. The apical half of the anterior wings, except the margins, is wholly brown, the basal half hyaline, with the narrow subcostal band as in the male.

"Described from one ♀ and two ♂ specimens, taken by Mr. Herbert H. Smith, at Chapada, South America, during the month of April, and in honor of whom this beautiful chalcid is named."

PENTACNEMUS gen. nov.

Male.—Antennæ inserted at margin of clypeus; scape subcylindrical, not quite reaching to anterior ocellus; pedicel short, stout, as broad as long; joint 1 of funicle as long as pedicel; joints 2 to 6 increasing in length; joints 1 to 5 each emitting a long hairy branch from apical end, the second and third branches longest, the first and fifth subequal, the third joint nearly equal in length to joints 4, 5, and 6 of the funicle combined; club elongate ovate, nearly equal in length to joints 5 and 6 of the funicle. Ocelli at the angles of an obtuse-angle triangle. Occipital margin very sharp. Mesoscutum without grooves. Scapulæ meeting at tips. Mesoscutellum as long as mesoscutum, well arched laterally. Submarginal vein gives off stigma at a little less than half the length of fore wing. Marginal vein wanting. Stigmal vein short, oblique; postmarginal shorter than stigmal. Middle tibial spur long, slender, as long as first tarsal joint.

Female.—Resembles in some respects *Copidosoma*, particularly in antennal structure. The scape is long and cylindrical; pedicel short, obconical, stout; joint 1 of funicle narrower than pedicel; joints 1 to 6 of funicle subequal in length and width; club large, laterally somewhat flattened, and very obliquely truncate, nearly equaling in length the five preceding funicle joints. Face differs from Copidosoma in being closely and shallowly punctuate instead of with sparse deep punctures. In other respects resembles the male.

Pentacnemus bucculatricis sp. nov.

Male.—Length, 1mm; expanse, 2.5mm; greatest width of fore wing 0.5mm. Head and mesonotum very closely punctuate; abdomen smooth, shining. Color: Head and mesoscutum brilliant metallic green, mesoscutellum dark metallic bronze; other parts of trunk shining black, except that the abdomen has a variable brown spot below at base; antennæ

uniform dark brown; all coxæ black, all femora and tibiæ dark brown, light at tips; middle tibial spur nearly white; all tarsi light honey-yellow, black at tips; wings perfectly hyaline; wing veins rather light, except the short post marginal, which is brown.

Female.—Length, 1.16mm; expanse, 2.4mm; greatest width of fore wing, 0.46mm. In punctation and coloration closely resembles the male, except that the tips of antennal scape and pedicel are lighter in color than the rest of antennæ.

Described from thirteen ♂, twenty ♀ specimens reared May 16 to 20, 1891, from over-wintered cocoons of *Bucculatrix thujella* Pack., received April 25, from J. G. Barlow, Cadet, Mo.

TETRACLADIA gen. nov.

Male.—In its four-ramose antennæ resembles *Tetracnemus* Westwood and *Tanaostigma* How. From the former it is at once distinguished by the scapulæ meeting at tip, and from the latter by its rounded occipital ridge and the absence of ring joints to the antennæ. Antennæ eleven-jointed; scape inserted half way between middle of face and mouth, slightly broadened below; pedicel conical, its breadth at tip equaling its length; joint 1 of funicle very short, broader than long; funicle joints 2, 3, and 4 very short, each giving out a long branch, of which that from joint 1 is longest and stoutest; joint 5 of funicle nearly as long as scape, giving off a short branch at tip; joint 6 somewhat shorter than joint 4; club as long as joint 5, large, ovate. Antennal grooves converge towards front, leaving a regularly rounded ridge; ocelli at corners of a somewhat obtuse-angled triangle; eyes very far apart; occipital ridge rounded. Dorsum of thorax rather flat; scapulæ meeting at tips. Submarginal vein reaches costa at half the wing length; marginal vein short, about one-sixth the length of the submarginal; postmarginal somewhat shorter than marginal; stigmal slender and very short, shorter than postmarginal, descending at a wide angle from postmarginal and bearing a large and well-marked club. Hind femora of unusual thickness.

Tetracladia texana sp. nov.

Male.—Length, 1.4mm; expanse, 2.5mm; greatest width of fore wing, 0.46mm. Head, pro- and mesonotum very closely and finely shagreened and with small sparse punctures; a close row of small punctures around border of eyes; genal sulcus absent; entire tergal surface of abdomen also delicately shagreened, but without punctures. Color: Head, pronotum, and mesoscutum metallic green; mesoscutellum greenish bronze; abdomen and venter of thorax black; scape of antennæ brown; flagellum black; all coxæ, femora, and tibiæ, black, with faint greenish reflections on coxæ and femora, and the tips of tibiæ yellowish; middle tibial spur light honey yellow; wings nearly hyaline; wing veins dark brown, a dark shade or brownish patch just below marginal,

and a faint infuscation spreading from this and broadening towards anal margin of wing.

Described from 2 ♂ specimens collected by Nathan Banks at College Station Texas.

Tetracladia gracilis sp. nov.

Male.—Length, 1.44mm; expanse, 2.9mm. Longer and slenderer than *T. texana;* antennæ longer and slenderer, except joints 1, 2, 3, and 4 of the funicle, resembling closely the antennæ which Westwood has figured for *Tetracnemus diversicornis*, except that the four branches are borne on funicle joints 2, 3, 4, and 5 instead of 1, 2, 3, and 4. Head and mesoscutum closely and finely reticulate, the reticulation becoming transverse on face; no sparse punctures; genal sulcus sharp and complete; mesoscutellum and scapulæ nearly smooth, very faintly reticulate; dorsum of abdomen faintly shagreened. Color: Antennæ black; head and thorax metallic green, mesoscutellum somewhat bronzy, and scapulæ with a faint purplish reflection; mesopleura brilliant purple, greenish at base; abdomen black, shining, with greenish or bluish reflections; all coxæ and femora metallic green; all tibiæ black, yellowish at tips; all tarsi honey-yellow with dark terminal joints; middle tibial spur honey-yellow; wings perfectly hyaline.

Described from 2 ♂ specimens collected in east Florida by Mr. Ashmead.

CALOCERINUS gen. nov.

Male.—Resembles *Tetracladia*, from which it differs mainly in the extraordinary length of joint 6 of the funicle, and of the branch of joint 5. Scape inserted slightly below middle of face, subcylindrical, not broadened below, long, curved slightly backwards, reaching to lateral ocellus; pedicel as broad as long; joints 1 to 4 of the funicle as in *Tetracladia*, joint 5 a trifle longer than 1 to 4 together; joint 6 about four times as long as 5, growing gradually stouter towards tip; club, long oval, slightly broader than tip of preceding joint, and nearly one-half as long. Face broad, well rounded; occipital ridge rounded, but more acute than in *Tetracladia;* ocelli forming an obtuse-angled triangle; head broader than thorax and with a very short occipito-frontal diameter; mesonotum well rounded, scutellum rounded at tip, scapulæ meeting at tip. Wing venation same as in *Tetracladia;* fore wings partially infuscated. Legs rather long; hind femora not so much enlarged as in *Tetracladia.*

The abdomen is broken off at second joint with the only specimen, and therefore its shape and other characters are unknown.

Calocerinus floridanus (Ashm.).

Tetracnemus floridanus Ashm. Proc. Entom. Soc., Acad. Nat. Sci., Phil., 1885, Vol. 12. p. xviii.

Male.—Length, 2.1^{mm} (estimating abdomen as one-third length of body); expanse, 4.1^{mm}; greatest width of fore wing 0.58^{mm}. Face with sparse whitish pubescence, finely shagreened, with sparse shallow punctures; cheeks shagreened, but without the pubescence or the punctures which end abruptly at the faintly indicated genal sulcus; mesonotum finely and closely shagreened, without punctures. General color metallic green, with slight purplish luster at vertex; mesopleura brilliant purple, metallic green at base; antennal scape honey-yellow, pedicel and flagellum black; front and middle femora brown, tibiæ lighter, tarsi very light, middle tibial spur concolorous with tarsi; hind femora black with metallic reflections, tibiæ very dark brown, lighter at ends, tarsi light brown; fore wings fuscous, with brown pubescence, but with two irregular, wedge-shaped, white patches, the one with its base upon the costa immediately beyond the stigmal vein, and the other with its base upon the anal margin immediately opposite, their apices nearly meeting in the middle of the wing; basal one-fifth of the wing hairless, with a small distal patch of white pubescence, to which comes obliquely a hairless streak from the marginal vein; veins dark brown, the origin of the stigmal almost obscured by the brown pubescence, which is denser here than at any other point of the wing.

Described from one ♂ specimen collected by Mr. Ashmead near Jacksonville, Fla.

EXPLANATION TO PLATES.

PLATE XLVI.

Fig. 1. *Tetracladia texana* Howard, male greatly enlarged (original).

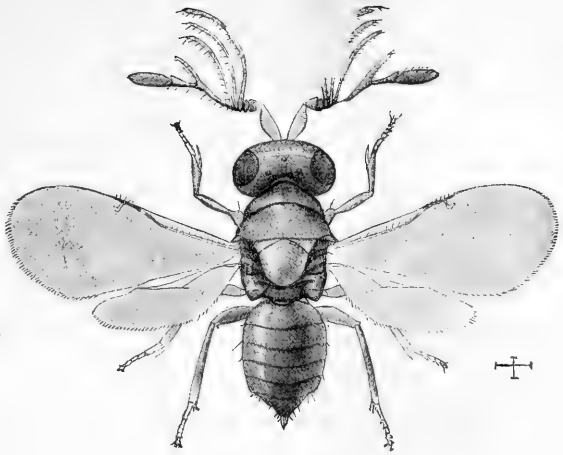
2. *Tetracnemus diversicornis* Westwood; greatly enlarged (redrawn from Westwood).

3. *Tanaostigma coursetiæ* Howard: *a*, ovary of *Willardia mexicana* with the Tanaostigma just issuing; *b*, adult male, enlarged; *c*, male antenna; *d*, female antenna; *e*, veins of fore wing; *f*, tip of middle tibia and tarsus, still more enlarged (after Howard).

PLATE XLVII.

Fig. 1. *Pentacnemus bucculatricis* Howard: *a*, adult male, enlarged; *b*, tip of middle tibia and tarsus; *c*, veins of fore wing; *d*, tip of front tibia and tarsus; *e*, male antenna; *f*, female antenna, still more enlarged (original).

2. *Hexacladia smithii* Ashmead, adult male with outline of female antenna above, enlarged (after Ashmead).



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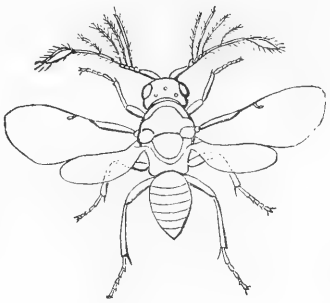

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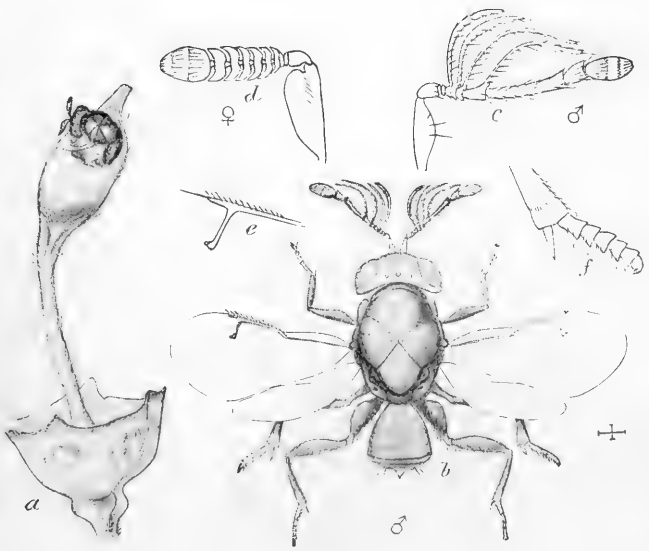
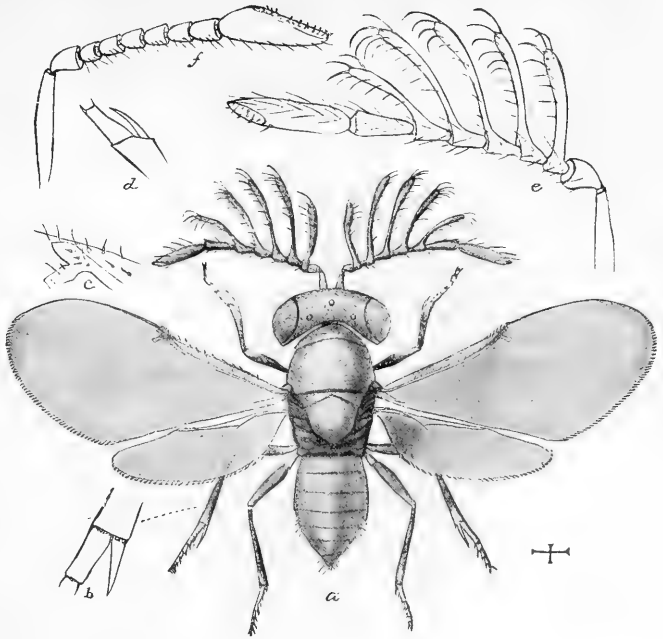


3

ENCYRTINÆ.



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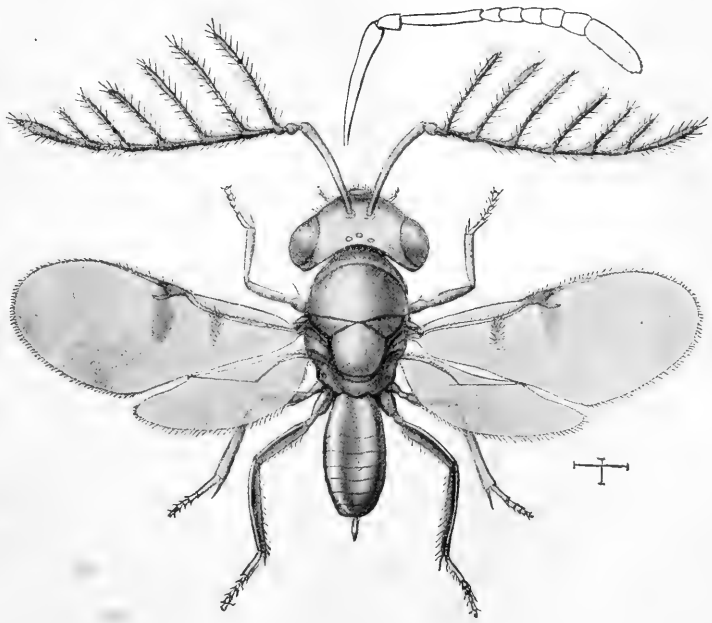

2

ENCYRTINÆ.

TWO ADDITIONS TO THE JAPANESE AVIFAUNA, INCLUDING DESCRIPTION OF A NEW SPECIES.

BY

LEONHARD STEJNEGER,

Curator of the Department of Reptiles and Batrachians.

A few specimens belonging to the Science College Museum in Tokyo have been received by mail from Dr. Ijima in advance of a more extensive collection, but as they are quite interesting in themselves, and as a considerable time may lapse before I shall be able to report upon the larger collection, I have thought it best to embody my remarks upon the present specimens in a separate paper.

Tringa temminckii (LEISL.).

A young bird (Sc. Coll. Mus., No. 2193; ♂ ?) collected in the neighborhood of Tokyo, during the autumn of 1891, is an interesting addition to the Japanese avifauna.

Synonymy and East Asiatic references to this species may be found in my Results of Ornithological Explorations in Kamtschatka, etc., p. 119, and the distinctive characters are indicated *op. cit.*, p. 117.

Tringa temminckii has already figured among the Japanese birds (Blakiston, Ibis, 1862, p. 330), but the record rested upon an erroneous identification, as the birds collected were *T. ruficollis*, the correction being made by Blakiston himself (Trans. As. Soc. Jap., VIII, 1880, p. 195), and Palmén's reference (Vega Exp. Vet. Arb., V, 1887, p. 320) to it as occurring in northern Japan during the migrations must be corrected accordingly.

T. temminckii, thus for the first time correctly attributed to Japan, is apparently only an occasional visitor during the migrations, although it occurs and breeds in the countries to the north of it. Palmén (*l. c.*) shows that it is not uncommon on the Tchuktchi peninsula; Kittlitz has recorded it from Kamtchatka (Denkw., II, 1858, p. 196), and I have collected it on Bering Island.*

* Seebohm in his "Distribution of the Charadriidæ," p. 435 (1887), says that it "has not been recorded from Kamtschatka" in spite of the fact that two years previously I had recorded four specimens from Bering Island (Res. Orn. Expl., Kamtsch., 1885, p. 119), and in spite of Kittlitz's record. The latter I have doubted somewhat, as Kittlitz only gives the name without adding anything that will aid us in ascertaining the correctness of his identification.

The Russian ornithologists have it from the west coast of the Okhotsk Sea. It has, therefore, a migration route similar to *Tringa ferruginea*. The migrations of these birds in Eastern Asia are referred to more fully in my above-mentioned book (pp. 346–347).

Acanthopneuste ijimæ sp. nov.

DIAGNOSIS: Similar to *A. coronatus*, but top of head uniform with the back, and no coronal band; under tail-coverts yellow; second primary longer than seventh, shorter than sixth.

HABITAT: Seven Islands (of Idzu), Japan.

TYPE: U. S. National Museum, No. 111663; Idzumura, Miyakeshima, May 3, 1887; M. Namije coll.

SYNONYM: *Phyllopseustes coronatus* Stejneger, Pr. U. S. Nat. Mus., 1887, p. 486 (*nec* Temm. & Schl.).

When first reporting upon the birds of the Idzu Islands I had only one specimen of this species before me and a pretty poor series of *A. coronatus* for comparison. As the specimen in question in other particulars, viz: in the intensity and pureness of the green of the back, the whiteness of the under parts contrasting strongly with the yellow under tail-coverts, in wing-formula, and in size agreed with *A. coronatus*, it was assumed, rather hastily, I admit, that the absence of the characteristic head-pattern was due in some way, or another, to seasonal or individual variation. I never got over my suspicion, however, which almost amounted to a conviction when recently I came to reëxamine our now quite respectable series of *A. coronatus* with the result that the dark top of head and light crown patch is present even in the bird in the first plumage, in both sexes, and at all seasons. I wrote to Mr. Ijima kindly to forward me the other specimens collected by Mr. Namije in the Idzu Islands. He sends a pair (Sc. Coll. Mus., Nos. 187 and 188) which clearly show that we have to do with a different species. The whole top of the head is of the same greenish color as the back, and there is not the slightest trace of a median pale stripe. The plumage is in very good condition. The green of the lower back is even purer and richer than in *A. coronatus*.

There is no other species with which the present needs comparison except perhaps *A. plumbeitarsus* from the fact that the latter has sometimes been confounded with *A. coronatus* (for instance, by Middendorff), but they differ both in coloration, wing-formula, and size, as will be plain from the statements made in this paper.

There is nothing startling in receiving a new Phyllospeustine bird from these islands, which, it should be remembered, are the home of the well-differentiated *Turdus celænops*, and I can do nothing better than to name it for Dr. I. Ijima, who so successfully has taken up the study of the ornithology of his native country.

Measurements (in millimeters).

Museum and No.	Collector and No.	Sex and age.	Locality.	Date.	Total length.	Wing.	Tail-feathers.	Exposed culmen.	Tarsus.	Middle toe with claw.
U. S. Nat., 111663.	Namiye, 8*a*	♂ad*	Miyake, Idzu Isls., Japan.	May 3, 1887	125	64	47	10	19	14
Sc. Coll. Mus. Tokyo, 188.	Namiye, 12	♀ad.	Miyake, Idzu Isls., Japan.	May 1, 1887	120	61	44	9	18	14
Sc. Coll. Mus. Tokyo, 187.	Namiye, 8	♂ad.	Niishima, Idzu Isls., Japan.	Apr. 22, 1887	120	64	46	10	19	15

*Type.

ON THE EJECTION OF BLOOD FROM THE EYES OF HORNED TOADS.

BY
O. P. HAY.

Some years ago there moved into my neighborhood, from Texas, a family which included among its members two boys. These boys had brought along with them a few lizards belonging to the genus *Phrynosoma*, and popularly called Horned Toads. The boys told me that these little animals would sometimes, when teased, squirt blood out of their eyes. I did not handle them much and saw no evidences of such a sanguinary disposition as was imputed to them. I did not believe that the lizards could really squirt blood, nor did I wholly disbelieve the boys' story. I thought it possible that some gland about the head might secrete a red fluid, which might be ejected by the animal when there was occasion for its use.

During a part of the past summer I was, through the kindness of Mr. Leonhard Stejneger, curator, permitted to work in the Department of Reptiles of the National Museum. Near my desk there was a specimen of *Phrynosoma coronatum* which had been sent from California by a member of Dr. Merriam's exploring party. About the 1st of August it was shedding its outer skin, and the process appeared to be a difficult one, since the skin was dried and adhered closely. One day it occurred to me that it might facilitate matters if I should give the animal a wetting; so, taking it up, I carried it to a wash-basin of water near by and suddenly tossed the lizard into the water. The first surprise was probably experienced by the *Phrynosoma*, but the next surprise was my own, for on one side of the basin there suddenly appeared a number of spots of red fluid, which resembled blood. I immediately recalled what the boys had told me of the ability of Horned Toads to squirt blood, and I concluded that this was a good time to settle the question whether this fluid was blood or not. A microscope was soon procured and an examination was made, which immediately showed that the matter ejected was really blood.

The affair now became very interesting. Just where the blood came from I could not determine with certainty, the whole thing having happened so suddenly and unexpectedly; yet the appearance seemed to indicate that the blood came from the region about one of the eyes. There appeared to be a considerable quantity of the blood, since on the sides of the vessel and on the wall near it I counted ninety of the little splotches. A consultation was had with Mr. Stejneger the next

day with regard to the propriety of dashing the animal into the water again to discover, if possible, where the blood came from. It was thought, however, that such blood-lettings must be somewhat exhausting, and that it would be better to allow the animal a day to recuperate. While talking I picked up the lizard and was holding it between my thumb and middle finger, and stroking its horns with my fore-finger. All at once a quantity of blood was thrown out against my fingers, and a portion of it ran down on the animal's neck; and this blood came directly out of the right eye. It was shot backward and appeared to issue from the outer canthus. It was impossible to determine just how much there was of the blood, but it seemed that there must have been a quarter of a teaspoonful. I went so far as to taste a small quantity of it, but all that I could detect was a slight musky flavor.

All that I was able at that time to find in print concerning this strange habit of these animals is contained in Prof. S. F. Baird's "Annual Record of Science and Industry" for 1872, p. 256. It appears to be merely a clipping from a newspaper, and reads as follows:

> We published not long ago a notice of a peculiarity of the Horned Toad of California in the expulsion of a blood-like fluid from the eye, and a reader of the *Weekly* writes to give his own testimony to the fact. He states that he has caught numbers of these in Texas, and frequently noticed the ejection of the bloody fluid from the inner canthus of the eye, once receiving the discharge in his own eye, while holding the animal at a distance of at least a foot. The sensation experienced was quite painful for a few minutes.

Some very interesting questions arise regarding this strange habit. What is the purpose of the Horned Toad in thus besprinkling an enemy with its own blood? What is the source of the blood, and how is it expelled with such force? Is the habit practiced at all times of the year or only during certain conditions of the animal? I may state here that I was able to get the lizard to discharge blood only twice. Afterwards no amount of teasing sufficed to provoke it to a repetition of the act. This makes it appear probable that, as suggested by Mr. Stejneger, the habit is practiced only during the time of shedding the skin.

As to the purpose of the habit, it appears to me quite likely that it is done in order to defend itself from the attacks of its enemies, although it would not seem likely that blood would hurt the eyes much, notwithstanding the statement of the newspaper correspondent referred to above. Nevertheless, a discharge of blood into the eyes of some pursuing bird or snake might so seriously interfere with its clearness of vision that the lizard might make its escape while the enemy was wiping its eyes.

In order to determine, if possible, the source of the blood, an alcoholic specimen of the same species was dissected, but the investigation was fruitless. It appears to me useless to expect to find anything of the nature of a gland. Glands secrete materials from the blood, not blood itself. The most probable theory regarding the matter seems to be that there is lodged in the head, on each side, a blood sinus, a portion

of whose wall lies in the inner surface of the eyelid. This sinus is probably surrounded with muscular tissue of sufficient force to cause the thin wall in the lid to be ruptured and the blood to be ejected to a considerable distance. If this is the actual structure of the apparatus the rupture would soon heal and all things be ready for the next time of peril. Now, on turning up the upper lid of the eye of the living specimen the inner lining is seen to be very dark, not with pigment, apparently, but as if there were a quantity of blood there contained in a thin-walled vessel. However, if such an explanation is the correct one, the sinus, in order to contain sufficient blood, must be continued back into the head some distance. I hope ere long to secure materials sufficient to enable me to settle this interesting question.

Conversation with friends has elicited the fact that others have noted the remarkable habit referred to above. Prof. L. M. Underwood, of De Pauw University, has kindly sent me the following:

In answer to a request from Prof. O. P. Hay I give herewith my experience with a *Phrynosoma*.

In 1885 a student of mine received a specimen of Horned Toad from California. In examining the animal I took occasion to turn him on his back, using a lead pencil for the purpose. The animal resented this treatment and showed considerable anger, opening his mouth and puffing up his body. Irritating the animal still more, he grew more and more enraged, until finally blood spurted from just above his eye, which was fired at least a foot from the animal, as several spots struck my arm considerably above my wrist. After spurting the blood the animal became limp and collapsed, and remained in a stupor for some time, and, when handled, behaved as if dead. After a time, possibly not over five or six minutes, certainly not over ten, the animal revived and commenced to run about the table. Wishing to know if he would repeat the operation, I commenced to irritate him again in the same manner. After becoming enraged again the animal soon went through the same process, ejecting blood from the same eye as before. He then fell into a similar stupor and remained about the same length of time, after which he revived. No amount of irritation could produce a third discharge, although the animal showed some anger.

Mr. S. F. Denton, of Washington, D. C., has communicated to me his experience with the Horned Toad. About seventeen years ago he was at Sonora, Cal. He caught one day a very large Horned Toad. He had been told by the proprietor of the hotel that these animals were called by the Mexicans "sacred toads" "because they wept tears of blood." Mr. Denton scouted the idea, but it was not long before he had reason to confess his mistake. He was gently stroking the animal on the back, when it appeared to look at him as if taking aim, and then, all at once, a stream of blood was shot into his eye. There was so much of it that it ran down on his shirt bosom. He thought there was between a tablespoonful and a teaspoonful. The blood was shot out with so much force that some pain was produced, and there was pain felt for some little time, though this ceased as soon as the blood was wiped out. The next morning the eye was somewhat inflamed, but this condition soon passed away. Not long afterwards, perhaps the next morning, the animal squirted blood out of the other eye. Mr. Denton

states that he did not see that the lizard showed any signs of exhaustion or collapse after the operation. Neither did I observe anything of the kind in the case of the animal experimented with at Washington. Nevertheless, a brief period of stupor might have escaped the notice of both Mr. Denton and myself.*

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*While preparing this paper, Mr. Leonhard Stejneger has kindly called my attention to the fact that a notice of this remarkable habit of the *Phrynosomas* was published in 1871, in the Proceedings of the Zoological Society of London, pp. 1–2. At one of the meetings Mr. A. R. Wallace read extracts from letters of Mr. John Wallace, of Stockton, Cal. After describing the animal, which he says is there called the "Horned Toad," he proceeds as follows:

"Under certain circumstances, apparently as a means of defense, this creature squirts out from one of its eyes a jet of bright red liquid very much like blood. This I have observed three times from three different individuals, although I have caught many that did not do it. They do not generally use this defense when first captured, although I caught one a few days ago which squirted the liquid a distance of 6 inches over the back of my hand, and another ejected it when I flourished a bright knife before its eyes."

Dr. Günther (Biologia Centrali Americana, Zool., pt. LXXXIII, Feb., 1890, Reptiles, p. 77, footnote) refers to this notice and states that he had not been able by dissections of fresh specimens to find the source of what he calls "the secretion."

SOME OBSERVATIONS ON THE TURTLES OF THE GENUS MALACLEMYS.

BY
O. P. HAY.

Of the turtles belonging to the genus *Malaclemys* there are now recognized five species, two new ones having been described within recent years by Dr. G. Baur. The genus is a very distinct one, and is distinguished from *Chrysemys* especially by the extremely broad and flat crushing surfaces of both upper and lower jaws. As a result of the provision made for the support of these wide, horny, masticatory plates, the internal nares are thrown far back, so as to lie behind the level of the eyes. In the Catalogue of the Chelonians in the British Museum, 1889, Dr. G. A. Boulenger says that "the plastron is extensively united to the carapace by suture, with feeble axillary and inguinal peduncles, the latter ankylosed to the fifth costal plate." Sometime ago I macerated a large specimen, *M. geographica*, until the whole plastron fell away from the carapace, thus showing that there was no ankylosis of the parts.

The Map tortoise, *M. geographica*, was described by the naturalist Le Sueur, in the Journal of the Philadelphia Academy for 1817. In the Mémoires du Muséum de Paris for 1827, Le Sueur presented the description of another species of this genus from specimens which he had taken in the Wabash River, at New Harmony, Ind. Neither figure nor systematic name accompanied the description, although he appears to have had a name in manuscript, *pseudogeographica*. It is evident that Le Sueur had in mind the terrapin, which has for the most part gone by that name since then, although the description is in some respects erroneous. The first mention that I find of this manuscript name of Le Sueur is found in connection with the *Emys lesueurii*, described by Dr J. E. Gray in his Synopsis Reptilium, 1831. It is also given by Duméril and Bibron in Erpétologie Générale, vol. II, p. 256, as a synonym of *Emys geographica*, with the remark, "jeune age." In his work, Herpetology of North America, published in 1842, Dr. Holbrook recognized the fact that this terrapin is distinct from the earlier described *geographica*, and gave to it the name that Le Sueur had bestowed on it in his manuscripts. He also accompanied the description with a colored plate. It is from this date, 1842, that we must reckon in determining the tenability of the name *pseudogeographica*.

In 1831 Dr. J. E. Gray, in his Synopsis Reptilium, p. 31, published a description of a species which he called *Emys lesueurii*. This supposed new species was founded on either a specimen of *geographica* or on one of what Holbrook afterwards called *pseudogeographica*. Dr. Gray himself, in all his subsequent publications, wrote down the name *lesueurii* as a synonym of *geographica*, although previously to the publication of his Catalogue of the Shield Reptiles he did not recognize Le Sueur's *pseudogeographica* as being distinct from the earlier described *geographica*.

In 1857 Louis Agassiz, in his Natural History of the United States, arranged both the species referred to under the genus *Graptemys*. Of his *Graptemys lesueurii* he says: "This species is commonly called *Emys pseudogeographica*, but the specific name *Le Sueurii* is older. It is evident from his reference that Gray at first applied the name of *Emys Le Sueurii* to this species, and not to *Gr. geographica;* now Gray calls it also *Emys pseudo-geographica*." Since that time Prof. E. D. Cope, in his Check List of 1875, employed the name used by Holbrook, but Mr. F. W. True, in Dr. Yarrow's Check List of 1882, adopted Agassiz's suggestion and called the species *Malacoclemys lesueurii*.

Since now the name by which we are to know the species called by Le Sueur and Holbrook *pseudogeographica* depends on what Gray had before him when he described his *Emys lesueurii*, it becomes necessary, if possible, to determine that matter. More certainly depends on that than on Gray's references to any previous writings.

Among other differences existing between the two species of *Malaclemys* referred to here, is one which enables us in all cases to distinguish them. This is found in the form of the yellow spot which lies on the side of the head just behind the eye. In *M. geographica* this spot is broad, rather triangular, and elongated in the direction of the head. In the other species the spot is a transverse streak, running behind the eye and sometimes curving forward below it. Now, in his description of *Emys lesueurii*, Gray has this language: "Temporibus macula triangulari notatis." At the end of his description he further says: "*Emys geographica* of Le Sueur agrees with the museum specimen, except in that the first vertebral plate is not urn-shaped, and Le Sueur does not notice the triangular temporal spot." In that remark we have evidence that Gray had before him but a single specimen and that that specimen had the "ear-mark" of *geographica*. We further learn why he described it as different from Le Sueur's species. That Gray was at this time aware of the existence of Le Sueur's manuscript name appears from the following words at the end of the description:

"*β*. Scutello vertebrali primo urceolato." *Emys geographica*, Lesueur, Jour. Acad. N. S. Phil. t. *Emys pseudogeographica*, Lesueur Mss. (Mus. Paris.).

This is probably the reference that Agassiz alludes to, and it is hard to see why Gray introduces it here; but it no more proves that he had Le Sueur's *pseudographica* in mind than the other species. Indeed, he

regarded them as both the same thing. Furthermore, in his Catalogue of the Shield Reptiles, he refers this *β* to *pseudogeographica*, while his *lesueurii* is referred to *geographica*. It is evident that he regarded what he placed under *β* as different from the species he was describing. I make the suggestion that the quotation marks were put in front of the *β* through an error of writing or printing. As to the characters assigned to *lesueurii*, I submit that they apply much better to *M. geographica* than to *pseudogeographica*.

The subsequent history of these two species, so far as Dr. Gray is concerned, is as follows: In the Catalogue of Tortoises, published in 1844, he regards both *pseudogeographica* and *lesueurii* as synonyms of *geographica*. He does not appear at this time to have seen Dr. Holbrook's work of 1842. In his description of the *geographica* of the Catalogue of Tortoises, Dr. Gray says of the head-spot only that it is "a yellow streak on the temple." In making this description he had before him two specimens, which, according to his plan, he designates as *a* and *b*. Was either of these the one on which he had in 1831 based the species *lesueurii?* This is of some importance and will presently be considered.

By the time of the publication of the Catalogue of Shield Reptiles, in 1855, Dr. Gray had undergone another change of mind. He now recognized the existence of two entirely distinct species, and these he designates as *Emys geographica* and *E. pseudogeographica*. Of the latter species there were then in the British Museum seven specimens, five of which had certainly been received since 1844. The other two are distinctly stated to be the ones which had been recorded as *a* and *b* under *Emys geographica* in the work of 1844. Of *Emys geographica*, on the other hand, there was in 1855 only a single specimen in the Museum and that is expressly said to be the one which furnished the description of *E. lesueurii* in 1831. Even then Gray seemed to be a little doubtful about its being the same as Le Sueur's *geographica*, but his description of it removes all doubt. He contrasts it sharply with the specimens of *pseudogeographica*.

All these facts indicate that in 1844, when Gray wrote the Catalogue of Tortoises, the type of *E. lesueurii* was not in his hands. It had probably been misplaced and for the time being lost. The descriptions of that work had been drawn from two specimens of *pseudogeographica*. When the Catalogue of Shield Reptiles was written, the specimen had been recovered, and Gray was enabled to compare it with specimens of the other species and with Holbrook's descriptions and figures. It is spoken of as "animal dry, from spirits," "the Museum specimen is in a bad state." Something concerning its history may be inferred from these remarks.

Dr. Boulenger, in his Catalogue of Chelonians, 1889, accepts the specific name *lesueurii*, instead of *pseudogeographica*. No mention is made of the specimen which served Dr. Gray as the type of *lesueurii*.

With the evidence before us, we must, it seems to me, accept the name *pseudogeographica* for the species under consideration. To reject it will be to ignore Gray's statements, repeatedly made, that his *lesueurii* is a synonym of *geographica*, as well as the plain language of his descriptions. It may be a very objectionable name, but the laws of priority must be rigidly observed.

The masticatory surfaces of *M. geographica* are much broader than those of *M. pseudogeographica*, and we might infer therefrom that the food of the two species is not the same. In Volume XXII of the Bulletins of the Essex Institute, Prof. Harry Garman has made the observation that the broad surfaces of *M. geographica* are employed in crushing the shells of mollusks, the remains of which he found in their stomachs. In the stomachs of *M. pseudogeographica*, on the other hand, he found the remains of a species of sedge, as well as some animal matter. During the last spring, at a meeting of the Indiana Academy of Sciences at Lake Maxinkuckee, in northern Indiana, three or four of us, within a few hours, captured about thirty specimens of *M. geographica*. These specimens were almost invariably taken in the water near the shores of the lake where the bottom was covered with the shells, living and dead, of *Vivipara contectoides*. Seven of the terrapins were taken home and kept some days in a washtub partially filled with water. When they were taken out, there were found on the bottom of the tub large numbers of the opercula of that water snail. In the alimentary canal of one terrapin were found these opercula, as well as the remains of crayfishes, and what appeared to be the cases of some species of caddis-worm. The masticatory surfaces of the older specimens were found to be much worn. The crushing surfaces of Dr. Baur's recently described *M. oculifera* are rather narrow, while the cutting edges of the jaw are very sharp. The indications are that the food does not consist of mollusks, but rather of some soft vegetable and animal substances.

Most, if not all, the species of this genus are extremely variable in the size of the head. In the paper referred to above, Prof. Garman attempts to give us the characters that distinguish *geographica* from *pseudogeographica*, and among such differential characters is the size of the head relative to the length of the carapace. *Geographica* is stated to have a large head; *pseudogeographica* a much smaller head. He also presents measurements that appear to prove his position. Dr. Holbrook long ago described a specimen of *geographica* under the name of *Emys megacephala*, the name being suggested by the massive head. Some years ago Dr. Gray suggested that the large head might be a sexual character, but he did not state which have the big heads, the males or the females. Through the kindness of Mr. Stejneger, I have been permitted to examine all the specimens of both species that are in the National Museum, and I have also examined a number of specimens of both the species in my own collection. I find that the size of the head is not a specific, but a sexual, character, and that it is the

females which have the large heads. The heads of the males are much smaller and also more pointed. I believe that the same statements are true regarding the salt-water terrapin, *Malaclemys terrapin*, although I have not been able to examine a sufficient number of specimens to be certain about it. With regard to the other two species referred to I am quite certain that no appreciable differences will be found between them, when we compare specimens of the same size and sex.

Another interesting matter pertaining to most, if not all, the species of this genus is the size of the male as compared with that of the female. Le Conte is the only author who has, so far as I am aware, made the observation that the male of the salt-water terrapin is small. Of the seven specimens of *M. geographica* taken by myself at Lake Maxinkuckee, three had the carapace $3\frac{3}{4}$ inches long, while the other four had a length of carapace ranging from $6\frac{3}{4}$ to 9 inches. Dissections proved that all the small specimens were males and the large ones females. The same statements are true of such specimens of *M. pseudogeographica* as I have examined. All the specimens of *M. oculifera* BAUR in the National Museum are, judging from the form of the shell, females; and they are all large specimens. Both Agassiz and Baur have observed that the males of *Trionyx spiniferus* are smaller than the females. On the other hand, the largest specimen of *Chelydra serpentina* that I have ever seen was a male, and I believe that the males of the various species of the genus *Chrysemys*, as defined by Boulenger, exceed the females in size.

It is quite characteristic of the species of the genus *Malaclemys* to have a prominent keel along the middle of the carapace, and this is often nodose. In *M. pseudogeographica* the keel is nodose all through life. However, all the species, so far as we know, have these elevations along the keel when young. In some of the young of the salt-water terrapin I found that the nodosities were especially large and globular. They resembled greatly a row of medium-sized peas, four or five in number, lying along the back. The species *M. geographica*, having such a nodose keel while young, but losing it as age advances, must be regarded as attaining a higher stage of development than *pseudogeographica*, which retains this embryonic character throughout life. The young of *M. oculifera* will undoubtedly be found to have a distinct and nodose keel.

Agassiz (*loc. cit.* p. 260) discusses the various ways in which the different kinds of turtles get rid of the older layers of the epidermis. He mentions certain species of fresh-water turtles, among them *M. pseudogeographica*, in which he observed in the spring the uppermost layer of the dermal plates to be cast off at once as one continuous, thin, mica-like scale all over the plate. In a number of very young specimens of *M. geographica* taken at Lake Maxinkuckee, the outer layer of the epidermis was lifted up from the underlying layers by a quantity of fluid. This was preparatory, no doubt, to the casting off of the epidermal layer.

ON THE BREEDING HABITS, EGGS, AND YOUNG OF CERTAIN SNAKES.

BY
O. P. HAY.

Notwithstanding the deep impression which serpents have made on the human mind, as shown in literature and in popular conversation, it is surprising how little accurate information has been accumulated concerning some of their habits. The densest ignorance, the result of inattention and general lack of interest, prevails with regard to some of the most interesting matters connected with the life-history of snakes; while, on the other hand, many of the popular notions about the powers of these animals are either wholly false or are gross exaggerations of the truth. The breeding habits of our snakes, even of the most common species, belong among the things about which little is known. Even our biologists have given but little attention to this subject, while unscientific people simply recognize the fact that nests of snake eggs are occasionally met with. For instance, who would not suppose that all the essential facts are known concerning the reproduction of the common black-racer, *Bascanion constrictor?* Nevertheless, where have we been told when it lays its eggs, how many there are of them, how they are concealed, and when they hatch?

Some snakes are known to lay eggs which after a period produce young. Other snakes are known to retain the eggs within the body until the young have attained sufficient size and strength to care for themselves after birth. Still other species are supposed sometimes to lay eggs; at other times to bring forth living young,* or to produce some eggs and some living young at the same time.† There are, indeed, oviparous snakes and snakes which are ovoviviparous, and there is a conspicuous difference in their eggs. The eggs of the oviparous species are furnished with a thick, tough, flexible covering, or "shell," while the eggs of the species which produce living young have coverings which are very thin and delicate. Now, should such eggs as the latter be laid any considerable period before the young are ready to be excluded, the thin envelopes would surely be torn during the writhings of the embryo. That some of the eggs may be only partially developed at the time when the embryos of other eggs are ready to be ushered

* Proc. A. A. A. S., 1873, p. 185.

† Proc. Phil. Acad. Sci., 1887, p. 12.1

‡ Proceedings National Museum, Vol. XV, No. 909.

into the world, and that all may be expelled together, is possible; but this is not the normal course of things and may not be well for the immature young. Normally the coverings of such eggs are ruptured before birth or immediately afterwards. On the other hand, it is quite probable that the eggs of the oviparous species are laid a considerable period before they are hatched. The tough coverings of such eggs protect them from attacks and injuries from without, and at the same time resist the movements of the young snake within. So far as we know, these eggs are deposited in the earth, in piles of decaying vegetable matter, and similar places.

A very curious structure deserves mention here. This is the "egg-tooth," a small tooth fixed to the united premaxillary bones and projecting forward slightly beyond the edge of the upper lip. It is present only in the embryo, and is shed very shortly after the escape of the young snake from the egg. In the ovoviviparous species, the tooth may apparently be shed before the young are born. The tooth is employed by the little snake in ripping open the tough egg-covering in its efforts to escape from its prison. It would appear to be of little service to the young which are mature when born, since the egg-coverings are so very tender; nevertheless, I have found the tooth present in all the ovoviviparous species whose young I have had opportunity to study. This tooth, as found in the black-racer, was described as long ago as 1857 by Dr. Weinland;* but Müller had observed it even earlier.

The Crotalidæ, including the rattlesnake, the copperhead, and the water-moccasin, all, so far as I am able to discover, bring forth living young. The number produced at each birth is small as compared with the number of young sent into the world by some other species.

As to the breeding habits of the copperhead, *Agkistrodon contortrix*, we have the statement of Dr. J. A. Allen† that in Massachusetts five out of seven females caught in the latter part of July contained slightly developed embryos, while of six killed in September, the oviducts of each contained from seven to nine young, each of which had a length of 6 inches. As to the time of the pairing of the sexes, I have knowledge of only one observation. My friend, Rev. A. M. Hall, brought me from western Pennsylvania two specimens of this species, which he took while pairing, on the 28th of August. Unfortunately, the female was disposed of before my investigation of this subject was begun. This observation and those of Dr. Allen, when considered together, seem to indicate a period of gestation of nearly a year.

The breeding habits of the water-moccasin, *Agkistrodon piscivorus*, are no doubt much like those of the copperhead. A female 26 inches long (U. S. Nat. Mus., No. 17968), which was taken on the Arkansas bank of the Mississippi River, just opposite Memphis, in the latter days

* Proc. Essex Institute, Vol. II, p. 28, pl. 1.

† Proc. Bost. Soc. Nat. Hist., 1868, Vol. XII, p. 179.

of June, contains seven eggs, four of which are in the left oviduct. Usually the larger number of eggs in snakes is found in the right oviduct. The eggs of this specimen are about the size of the yolk of a hen's egg. In each is an embryo not larger than a common pea.

The breeding habits of *Crotalus* do not appear to be well known. Prof. Putnam * dissected a female which he says contained in the oviducts eight fully formed eggs, besides a number of smaller ones, which he supposed belonged to a later brood. It is more probable that all the eggs were really in the ovaries. A female rattlesnake, 39 inches long (U. S. Nat. Mus., No. 17959), was brought to me from western Pennsylvania by Mr. Hall. In this I find nine eggs, four of which are in the left oviduct. The eggs will average nearly an inch and a half in long, and an inch in short, diameter. In one of them I find an embryo about 3 inches long. The egg-coverings are extremely thin. The mother snake was captured some time in August, probably before the 15th. At what time of year the sexes unite I find nothing on record. Prof. S. W. Williston, who has had abundant opportunities for making observations on *C. confluentus*, states that the sexes pair in May. Nor do I know how large the young are at the time of their birth. M. Palisot Beauvois, as quoted by Dr. Goode, † says that he saw five young run into the mouth of a mother snake, and that these young were about the size of a goose quill. The young are undoubtedly much larger than this statement makes them. There is apparently as strong a tendency in observers to minify the size of the young of snakes as there is to magnify the size of the adults.

I have been enabled to make some observations on *Crotalophorus catenatus* Raf. (*Crotalus tergeminus* Say.). In the American Naturalist for March, 1887, pp. 211–218, I published some notes on the breeding habits and young of this species. About September 1 two females, which had been kept in confinement, brought forth young, one six, the other seven. The young were not seen by myself at the time of birth, but on the 1st of January they were at least 10 inches long. From a female sent me from Paris, Ill., I have taken an almost fully developed embryo (U. S. Nat. Mus., No. 17947). It measures 7½ inches in length, and this is probably nearly the length which it would have been when born. A considerable amount of the yolk was still spread over and among the coils of the little snake; but, when its body was opened, a large mass of the yolk was seen to have been received within its walls. This would be sufficient to maintain life and growth until the little reptile could provide for its own necessities. The fang is developed, and the egg-tooth is present, although it does not seem to be directed so much forward as in other species. In the oviduct, lying alongside of the embryo just described, was another egg which contained an embryo only about four inches in length. It was so deeply immersed in the yolk that its pres-

*Amer Nat., Vol. II., p. 133.

†Amer. Nat., Vol. XII, p. 207. Proc. A. A. A. S., 1873, p. 183.

ence was not suspected until the yolk was cut partially away. Nevertheless this immature little snake exhibits quite distinctly the pattern of coloration found in the adults. In contact with this egg was another in which no indications of an embryo were to be found. The more immature young were probably lying farther forward in the animal, but of this I am not now certain. Should all these eggs be expelled from the mother's body at the same time, it would seem that the least developed young must perish. A female (U. S. Nat. Mus., No. 17950) of of this species taken in Hamilton county, Ind., contained eight eggs, and these had not yet left the ovaries. Three of the eggs were in the left ovary. The eggs were an inch long by half an inch in the short diameter. Prof. Putnam mentions* a specimen of *Crotalophorus miliarius* which contained fourteen eggs. This appears to be a larger number than is usually found in the Crotalidæ.

The species of the genus *Eutainia* are probably all ovoviviparous. Dr. Goode, as already cited, says that there is some reason to believe that some of them are in some instances oviparous, in others ovoviviparous. Dr. C. C. Abbott† says that the eggs of the garter-snake, *E. sirtalis*, and of the ribbon-snake, *E. saurita*, are deposited in the loose sandy soil of the recently plowed fields. He has found none earlier than May 9; and once he found a complement of seventeen within a day or two of hatching. He farther states that he has never come across a young snake less than 4 inches in length, except in the case of the hog-nosed snake *Heterodon platirhinos*. I am convinced that there is some error of observation here. I shall present evidence that the species of *Eutainia* bring forth living young, and that too rather late in the summer and in autumn. It seems improbable that a snake should usually be ovoviviparous, and again, at rare times, should lay eggs furnished with coverings suitable for protecting the developing embryos. If notwithstanding all this, the *Eutainias* do lay spring eggs, I shall be extremely glad to receive a batch of them.

Dr. H. C. Bumpus, in his interesting account of the snakes,‡ says that the eggs of *Eutainia sirtalis* and of *E. saurita* are sometimes found about outbuildings, and in hatching give birth to little fellows having enormous eyes and a spotted body, the longitudinal bands of the adults only being gained after several sloughings of the skin. The source of the information here detailed is not given; but almost certainly the eggs of some other species have been mistaken for those of *Eutainia*. Young of both the species, especially those of *saurita*, taken by myself from the oviducts of the female and with a considerable portion of the yolk still unabsorbed, have the stripes perfectly distinct.

As to *E. sirtalis*, Prof. F. W. Putnam§ states that a female taken July 22 contained forty-two nearly developed young. Each of these

*Amer. Nat., Vol. II, p. 134.
† Rambles, &c., p. 295.
‡ Riverside Natural History, Vol. III, p. 371.
§ Amer. Nat., Vol. II, p. 134.

was 5½ inches long. The mother snake was 35 inches long. Dr. J. Schneck, of Mount Carmel, Ill., writes* that seventy-eight were taken from a female. He implies that he saw this done. C. Few Seiss says† that the sexes of this species copulate in early spring and produce from thirteen to eighty young. That he has seen the latter number from a single snake he does not say. Drs. Coues and Yarrow refer‡ to the habits of *Eutainia sirtalis parietalis*, as observed by them in Montana during the month of August. "At this season all the female individuals observed were gravid with nearly matured embryos. Like others of the genus, this species is ovoviviparous, the young being some 6 inches in length when born." In a specimen of *E. sirtalis* (U. S. Nat. Mus., No. 17960) captured near the city of Indianopolis by Dr. Alex. Jameson about August 1, I find thirty-nine partially developed young. Of these twentyfive are in the right uterus. The young measure 6 inches in length. There is a considerable amount of yolk still remaining attached to these young, a fact which indicates that they will increase in size before birth. An examination of the mouth of some of these little snakes shows that the egg-tooth is present. The membrane which surrounds each egg is quite thin. The female bearing this lot of young is 33 inches in length. Another female (U. S. Nat. Mus., No. 17961), from Paris, Ill., of nearly the same size, contained about thirty-five young snakes, these being packed together so densely in the mother's body that it was difficult to determine the number accurately without removing them. They are each 7 inches long, and are evidently just ready to be expelled. An examination of about half a dozen of them failed to reveal the presence of the egg-tooth, which has therefore been shed. Nor could I determine with certainty that any egg-covering was present. The yolk of the egg, also, is wholly consumed. On opening these young snakes I find little or none of the yolk within the body. In this respect they contrast strongly with the young of the rattlesnakes. The young garter-snakes must from the first depend on their own activities for support. This accords well with the report of Mr. C. Few Seiss,† that the young of a female kept in confinement began to feed shortly after birth, struggling vigorously with one another for the earthworms thrown them. At what time during the summer the Paris, Ill., specimen was captured I do not know. Seiss' statement that the sexes of *E. sirtalis* pair in the early spring has already been mentioned. Drs. Coues and Yarrow (*op. cit.*, p. 278) tell us that the females of the closely related species, *E. radix*, are pregnant in July and August, bringing forth as many as thirty to forty young; and that they are found *in coitu* in September and October. Can it be that snakes copulate twice in the year, as Agassiz says§ some turtles do, and as Gage has recently found‖ to be the habit of the newt, *Diemyctylus?* Observations on this point are to be desired.

*Amer. Nat., Vol. XVI, p. 1008.
†Scientific Amer., Vol. LXIII, p. 105.
‡Bulletins U. S. Geol. & Geo. Survey, Vol. IV, p. 277.
§Contributions, Vol. II, p. 491.
‖Amer. Nat., Vol. XXV, p. 1091.

The ribbon-snake, *E. saurita*, appears to be wholly similar in its breeding habits to its relative just considered, although it probably does not bring forth so many young at each birth. Prof. Putnam informs* us that a female, taken in Massachusetts on July 13, had nine eggs, each three-fourths inch long and containing an embryo 2½ inches in length. Another, taken July 31, contained but four eggs, and these are ready to be burst by the young. The eggs containing the coiled embryos were then an inch and a quarter long, while the extended young had a length of 5½ inches. Dr. Goode has quoted† a note from Herman Strecker, of Reading, Pa., who states that some years previously he had found and caged a female of this species which soon produced thirty or more young ones. He supposed that the little snakes had been hidden in the mother's stomach. There is possibly some confusion here with *E. sirtalis*, judging merely from the number of the young. Prof. S. I. Smith, of the Sheffield Scientific School, is quoted § by Dr. Goode as having seen two young snakes, each 3 or 4 inches long, run down the mother's throat. The statement is no doubt incorrect, so far as regards the size of the young.

In a female (U. S. Nat. Mus., No. 17965) of the variety *faireyi*, taken probably in Mississippi, I find nine eggs, the hindermost three of which are in the left oviduct. The eggs are about three-quarters of an inch long and a third of an inch in the short diameter. The development of the embryo had just begun. In a female (U. S. Nat. Mus., No. 17952) of *faireyi*, 28 inches long, taken at Veedersburg, Ind., are twelve ovarian eggs of the same size as those just mentioned. The hinder four are in the left ovary. At what time of the year the two specimens last described were killed, I do not know. In a specimen of *faireyi*, 40 inches long (U. S. Nat. Mus., No. 17958), captured at Vicksburg, Miss., about the 4th of July, there are twenty young snakes, each close to 9 inches in length. The hindermost nine of these are in the left oviduct. All were evidently ready to be expelled. They did not appear to be contained in any egg-covering, and the egg-tooth was not found in any of the three which were examined. While this date is not quite so late as that given by Dr. Abbott for the finding of the eggs of this species in New Jersey, we must take into account the difference in the climate, and especially the difference in the size of the young snakes.

The species of the related genus *Tropidonotus* are also ovoviviparous. *T. sipedon*, our water-snake, is the commonest species of the genus in the eastern United States. It is extremely variable and reaches a large size. Prof. Putnam has a note regarding the breeding habits of this species.* He states that twenty-two of the young belonging to one family were found. Each of them was 8 inches long. Dr. Heilprin mentions‡ a large specimen from which thirty-three young were taken.

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*Amer. Nat. Vol. II, p. 134.

†Proc. A. A. A. S., 1873, p. 18.

‡Proc. Phil. Acad. Sci., 1887, p. 121.

These were in different stages of development. Some of the larger ones had absorbed all the yolk, while to others a considerable mass of this was attached. In a specimen (U. S. Nat. Mus., No. 17962) from some point in northern Indiana I find sixteen eggs, eight in each oviduct. The young are 7½ inches long, and each is provided with a well-developed egg-tooth. This is curved upward like a short horn, and tapers gradually to near the point, where it rounds off rapidly. The egg-membranes are thin. I have some reasons for believing that the larger specimens of this species will be found to produce a considerably larger number of young than the above observations indicate.

I have met with no statements regarding the breeding habits of either *Tropidonotus grahamii* or *T. leberis*, except that made by Miss Hopley,* to the effect that a specimen of the last-mentioned species in the Zoölogical Gardens produced in August five young and at the same time some eggs. What the state of development of these eggs was, and what became of them, we are not informed. I have a female specimen (No. 26) taken somewhere in Indiana, and in this I find eight eggs, of which three are in the left oviduct. There are no signs of beginning development. A gravid female (U. S. Nat. Mus., No. 17970), captured on July 15, and sent me by Mr. W. O. Wallace, of Wabash, Ind., is 24 inches long. There are eight eggs, two of which are in the left oviduct. The eggs are of different shapes, on account of pressure. A considerable amount of yolk is still present, an indication that the embryos are not yet completely developed. A measurement of one of these shows it to be 6½ inches long. The longitudinal bands of the upper surface are sufficiently well-displayed to enable one easily to determine the species, but the longitudinal brown ventral bands are not seen. I find no indications of the presence of the egg-tooth, although it is probably present.

Some years ago I killed a specimen of a female of *T. grahamii* in Bureau county, Ill. Of the specimen the skin and a few eggs (U. S. Nat. Mus., No. 17954) were preserved. The time of capture was about the middle of July or later. The mother snake was of such a rusty color that the species to which she belonged could not then be determined. One of the eggs measures an inch and a half in the long diameter by three-quarters transversely. A considerable mass of yolk is present, into one side of which an embryo snake is sunken. This embryo is 7 inches long; and, although thus immature, has its scales and its colors so perfect that there is no difficulty in assigning it to the proper species. The embryo is surrounded by a very thin egg-covering. No indications of the presence of the egg-tooth were seen until a series of sections through the snout were examined, when it appeared.

Tropidonotus kirtlandi is a rather common snake in central Indiana. One specimen (U. S. Nat. Mus., No. 17957) taken at Irvington contains three eggs in each ovary. Each egg is a little less than half an inch in length. Another specimen (U. S. Nat. Mus., No. 17953) from Winchester,

*Snakes, etc., Miss C. C. Hopley, p. 437.

Randolph county, has eight eggs in the ovaries. Each egg is seven-sixteenths of an inch in length. This species is in all probability ovoviviparous.

The species of *Storeria* are stated by Dr. Goode* to be oviparous; but Prof. Cope† regards them as ovoviviparous, and he is quite certainly correct in his conclusion. One female (No. 27) of *S. dekayi* sent me from Winchester, Ind., contains thirteen eggs, five of which are in the left ovary, the remainder in the right. The eggs have apparently not attained their full ovarian size. Another specimen (U. S. Nat. Mus., No. 17966) of this species, taken by Dr. D. S. Jordan, at Cumberland Gap, Tenn., about midsummer, is a foot long, and has in it eleven eggs, the hindermost three of which are in the left oviduct. Each egg is about three-eighths of an inch in length by one-quarter in short diameter. Another specimen (U. S. Nat. Mus., No. 17967), which was taken at Irvington, contains eight eggs in the oviducts, each including a very immature embryo an inch and a half in length. The eggs are about half an inch long. The membranes are extremely thin.

I find a few notes on the breeding habits of *Heterodon platirhinos*, the hog-nosed snake, viper, or spreading adder, as it is popularly known. Some of these contain statements which, to me, appear exaggerated. Dr. J. Schneck, of Mount Carmel, Ill., reports‡ that eighty-seven "young spotted spreading adders" were taken from the body of a wounded female. The author of the note did not see this done, but got his information from persons who did see it. I am strongly inclined to believe that the reptile was a *Tropidonotus sipedon*. Another writer§ in Pennsylvania gives an account of over one hundred young snakes issuing from a wound in the side of a female spreading adder. These young were each from 6 to 8 inches in length, and all were active and blowing vigorously. Neither did the author of this note see the escape of the snake, although he did see sixty-three of the young in alcohol. There may easily have been an error in the determination of the species to which these young snakes belonged. One who has examined the eggs of this species can not easily believe that so many young snakes could, with such readiness, escape from a wound in the mother's side. Moreover, these snakes deposit their eggs in the earth some time before the young are ready to lead an independent existence.

Dr. Bumpus (*op. cit.*, p. 364) states that a female *Heterodon* in the National Museum brought forth one hundred and eleven young; but Dr. Bumpus kindly informs me that he did not himself observe this.

Prof. F. W. Cragin reports‖ the finding, on September 10, of twenty-two eggs of this species. They were buried in the sand at East Hampton, Long Island. Two of the eggs, which he had in his possession, hatched four days afterwards. Troost appears to have dissected a black specimen, in which he found twenty-five eggs. Dr. C. C. Abbott says¶ that he

* Proc. A. A. A. S., 1873, p. 181.
† Proc. Phil. Acad. Sci., 1874, p. 116.
‡ Amer. Nat., Vol. XVI, p. 1008.
§ Amer. Nat., Vol. III, p. 555.
‖ Amer. Nat., Vol. XIII, p. 710.
¶ Rambles, etc., p. 289.

has frequently in May found the eggs of the hog-nosed snake in considerable numbers, a few inches below the surface of the ground; and in early July he once found a family of 17 very small, and apparently just hatched, young. These resented all interference, snapped, hissed, and flattened their heads precisely as an older snake would do. The size of the young is not given, but in another place (*op. cit.* p. 295) he implies that they were less than 4 inches in length. I think that this species, like most other species, produce their young rather later in the season; but I see no reason for not believing that some individuals may bear their eggs over the winter and lay them in the spring.

A female (U. S. Nat. Mus., No. 17951), sent me from Veedersburg, Fountain county, Ind., contained fifteen eggs, the posterior four of which lay in the left oviduct. I could discover no signs of embryos. Each egg was covered by a thick, tough, yellowish coat, inside of which was a thinner and more delicate membrane.

Through the kindness of Mr. L. Stejneger, curator of the department of reptiles in the National Museum, I have been enabled to make some observations on the eggs and living young of this *Heterodon*. On the 31st day of last August, there were brought into the laboratory of the Department, for some point in Maryland not far from Washington, a lot of twenty-seven eggs, which the finder said were the eggs of the copperhead. It was reported that the eggs were thrown up out of the ground by the plow, and that the mother snake was near by and had resented the disturbing of her treasures. She had been killed, but had not been sent along with the eggs. Since it was supposed that the copperhead produces living young, the occupants of the laboratory were anxious to learn if this opinion were erroneous. Accordingly one of the eggs was opened, and in it was found a young hog-nosed snake, fully developed, and ready to assist himself on the stage of action. This *Heterodon* quite closely resembles the copperhead, and most people are not accustomed to make nice distinctions among snakes. This close resemblance may account for some of the statements of the large number of young produced by the copperheads.*

The eggs referred to were between an inch and a quarter and an inch and a half long, and about seven-eighths inch in short diameter. The egg-covering was thick, tough, and flexible, resembling a piece of parchment. There is little if any deposit of lime in it. Of these eggs, some were found to have hatched during the night of September 6. Others, which were buried somewhat deeper in some clay, escaped from the eggs later; but all were out by the afternoon of the 8th. The length of such as were measured varied between 7 and 8 inches. From the moment of escape from the egg all were quite active, and manifested many of the characteristics of the adults. Some of the little fellows were quite saucy, and would make a pretense of striking at the approaching finger; but their efforts in that line were rather feeble. A

*Amer. Nat., Vol. XVII, p. 1235.

faint hiss was sometimes uttered, but that may not have been voluntary. One would sometimes flatten its head and body and rear up with the anterior third of its length free from the ground. If one did not know well their inoffensive natures, one would be excused for fearing to handle them. An extremely singular habit possessed by the adults is that of feigning death. On being struck or teased they will roll over and over, as if in the intensest agony, and then throw themselves on the back and lie there as if dead. Out of some fifteen of the young experimented with, I succeeded in getting only two or three to go through with this performance, but these did it to perfection. On being lightly struck a few times, they would turn over on the back, writhe about awhile, and then lie perfectly still. If turned right side up, they would again turn on the back. If left undisturbed for a little while they would turn over and creep slyly away. The others of the young would not act in this way, however much they were teased. It would be interesting to know whether all the adults possess this odd habit, or only a portion of them.

The cuticle of the young *Heterodons* is shed very shortly after their escape from the egg-coverings. Within a few minutes after one had left its prison the skin was observed to be broken about the head. It had left the egg at half-past 1 and by 4 o'clock the skin was pushed back half the length of the body. The next morning the skin was wholly shed, revealing the brighter colors of the new skin. While getting rid of the cuticle the little reptile kept crawling over the clay and among the roots of grass.

The opportunity was embraced to observe the use which is made of the egg-tooth. The tooth itself is easily seen in the just-hatched snake. Its lateral borders are more nearly parallel than those of the tooth of *Bascanion*, as figured by Weinland. Seen from the side, the anterior or upper outline is concave, the posterior outline convex. Thus, the tooth projects forward and is turned slightly up. The anterior face is also concave from side to side, so that there is, on each side, a distinct cutting edge. The tip is cut off square. The tooth appears to have a ligamentous attachment, and may be lifted a little, but not much depressed. It seems quite evident that the tooth is first engaged in the egg-covering and then made to do its work by a forward push of the head. An examination of the covering, after the snake has left it, gives ample proof that it has been cut and not merely torn. The edges are as smooth as if they had been slashed with a razor. A long slit is sometimes made as if by a single effort. In other cases, several attempts appear to have been made before the covering has been open enough for the snake to get out. In one or two cases, a tooth has not been inserted deeply enough, and the only result was a scratch on the inside of the covering. The egg-tooth having performed its office becomes loose and drops out. This occurs usually within twenty-four hours.

When the slit has been successfully made, the little snake may sometimes be seen pushing its head carefully out as if to survey the surroundings. Should there be any movement, the head will be quickly withdrawn.

I have been able to collect some facts concerning the pairing of the sexes of *Heterodon platirhinos*. Prof. U. O. Cox, of Mankato, Minn., informs me that he found two individuals uniting some time in May. A second male was entwined with the two other snakes. The latter were separated with difficulty. The male intromittent organs are described as being of an oval form, an inch long and over a half inch thick.

Two observers have seen the black specimens, formerly called *H. niger*, pairing with the spotted individuals. Prof. W. S. Blatchley* found a black and a spotted one copulating on April 19. He speaks in a letter to me of the intromittent organs as being as large as a walnut, and covered with spines. Mr. E. R. Quick, of Brookville, Ind., an accurate observer of nature, writes me that he once found a black viper pairing with a spotted one. The time, he thinks, was late in June. The time of gestation of this species is not known. It may continue from spring until autumn. Possibly the late-pairing individuals may retain their eggs until the next spring. Nor do we know how long the eggs are laid before they are ready to hatch. These matters are known concerning very few of our snakes, and a wide field is offered for work and observation.

Of the *Colubers*, I have been able to make observations on *C. obsoletus* alone. It is likely that others have observed and written on the subject, but I have not met with their statements. Dr. G. B. Goode reckonst this species among those which are ovoviviparous, but I am inclined to question this. My son, W. P. Hay, captured two of these snakes, near Indianapolis, while they were in sexual union. This was on June 19. The male (U. S. Nat. Mus., No. 17948) was 5 feet 5 inches long, the female (U. S. Nat. Mus., No. 17949) 6 feet 3 inches. When they were separated, the intromittent organs of the male were everted some 3 inches. A dissection shows that the hollow portion of the organ extends behind the vent 3 inches, while the retractor muscles form a cord which extends back nearly to the tip of the tail. At the base of the evertible portion, near the vent, the inner surface, which when the organ is everted becomes the outer surface, is furnished with numerous plications. Near the middle of the organ are found many hooked papillæ, some of them large and horny. The remainder of the organ has the surface raised up into numerous anastomozing folds, so that under the microscope it reminds one of the reticulum of the ox's stomach. On opening the female I find in her sixteen eggs. Of these eggs, four lie about the middle of the animal's body, while the other twelve occupy a much more anterior position; the one farthest forward being within 8 inches of the tip of the snake's snout, the hindermost one only

* Jour. Cincinnati Soc. Nat. Hist., 1891, p. 33.

† Proc. A. A. A. S. 1873, p. 185.

9 inches farther back. Several of these eggs are lying apparently loose in the body cavity. It might be supposed that they had just left the ovary and were about to enter the oviduct; but they are surrounded each with a covering nearly as thick and tough as that of the egg of the *Heterodon*. Could these eggs have been in the oviducts and then squeezed out into the body cavity during the time of being entwined with the male? The thickness of the egg covering makes it appear to me highly probable that the eggs are destined to be laid before the young will be mature enough for independent existence.*

Some years ago, in midsummer, I found a number of the eggs of the house snake which had been deposited in a pile of stable manure. This was in Bureau county, Ill. No record was kept of the number of the eggs, but a few of them (U. S. Nat. Mus., No. 17955) were preserved in alcohol. When found, the eggs were glued together into one mass. Each egg is 2 inches long and nearly an inch and a quarter in the short diameter. On the outside is found a thick, leathery, yellow covering, beneath which is a much thinner coat. From one of these eggs I have taken a young snake which measures $10\frac{3}{4}$ inches in length. Attached to this embryo is a considerable mass of yolk, a condition which indicates that the embryo is not ready for hatching. Nevertheless, all the generic and specific characters are well shown. There is a well-developed egg tooth. The intromittent organs are everted in the specimen examined. Each consists of a rather slender and twisted basal stalk, at the end of which is the swollen glans. This is acorn-shaped at the base, but terminates, at the distal end, in two blunt lobes. The base of the glans is densely spinose, the remainder reticulately papillose. The seminal groove winds around the basal stalk and terminates at the tip of one of the terminal lobes, the larger one.†

Concerning the breeding habits of the black-racer, *Bascanion constrictor*, I find little in print. It is well known that the young differ markedly from the adults, being decidedly spotted. Dr. Weinland, as already stated, described the egg-tooth. In one female, taken near

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*Since the above has gone to press, I have had the opportunity, April 29, of dissecting a recently captured female, the length of which was 4 feet 4 inches. The ovaries lie in the region situated about two-thirds the distance from the head to the vent. Each oviduct ends close to the corresponding ovary. It seems evident, therefore, that at least some of the eggs of the specimen described above are really lying loose in the body cavity. In the specimen dissected, the ovarian eggs are very immature, none of them exceeding about a quarter of an inch in length. It may be of some interest to add that this female had the anterior three-fourths of the body ornamented with blotches of a decided red color, the red occupying both the surfaces of the scales and the skin between them. The blotches were separated by scales which were partly yellow. Soon after death a great part of the red disappeared. The stomach contained eight wild mice, six of them young.

†I am able to state that *Coluber obsoletus* is oviparous. Mr. Thomas Marron, of the National Museum, early in April, 1889, collected a number of snake eggs in a hollow stump near the Potomac River. They were opened and found to contain fully developed young of this species, (U. S. Nat. Mus., No. 15334).—Leonhard Stejneger.

Indianapolis, I find nineteen eggs, seven of which lie in the left ovary. These eggs are quite immature.

Some alcoholic eggs (U. S. Nat. Mus., No. 17956) of this species from an unknown locality furnish some points. They are of the usual elongated oval form, an inch and a half long and close to an inch in short diameter. The outer covering is thick and tough, and it is furnished with numerous hard points, as if of deposits of lime salts. Within the egg is a young racer 10½ inches long and evidently nearly ready to come forth. The intromittent organs of this specimen are somewhat flattened, broad at the extremity, and with prominent terminal angles. The organ begins to expand from its base. It is furnished plentifully with spines. When the sexes unite, when the eggs are laid, how concealed, and when they hatch, are some of the things which we need to learn.

I have examined a specimen (U. S. Nat. Mus., No. 17969) of *Haldea striatula* from some point in Arkansas. It is 9½ inches long and contains five eggs, each with a young *Haldea* in it. Only the hindermost egg is in the left oviduct. This is a little over an inch long, but the others are only a little more than three-quarters. The short diameter of the egg is about a quarter of an inch. The embryos are far from mature, being only 2¾ inches long when extended. They have a considerable mass of yolk still attached to them. The egg-coverings are very thin. This circumstance causes me to conclude that the young are brought forth alive. A series of sections through the snout of an embryo reveals the presence of the usual egg-tooth.

NOTES ON THE FLOWERS OF ANTHOXANTHUM ODORATUM L.

BY

THEO. HOLM.

(With Plate XLVIII.)

It is a very interesting and highly instructive task to study the morphology of the Grass-flower. The numerous variations, which occur here are well fitted to confuse our ideas as to the identity of the constituents of the flower, and a mere look into the considerable literature upon this subject is sufficient to prove the difficulty of the study. While some authors have considered the development of the flower as the only reliable guide, others have thought to find the best explanation in the fully but abnormally developed flowers, of which several forms have been recorded in the *Graminæ*. It may not be denied that these aberrant forms, in many cases, are really worthless; but there are, on the other hand, not a few which seem to be of some use to morphological studies. But it would not be necessary to study, for instance, the nature of the glumes of viviparous specimens to find out that they are identical with bracts, because we are able to see that in the development of these organs; and in a similar instance has Goebel* taught us that the history of the development of the inflorescence in *Cenchrus* is sufficient to show that the so-called involucre is an abundantly ramified, but rudimentary system of axes, in which each axis aborts and merely shows a spine in the mature flower. Now, in regard to *Anthoxanthum* the true position of the floral organs and at the same time the morphological identity of these are so much disputed, having been studied from normal flowers, we propose to study the same, but from abnormally developed specimens.

The explanations which have been given by different authors as to the correct understanding of the flower, or rather the spikelet of *Anthoxanthum*, show a great divergency of opinion. Most commonly the spikelet is described as consisting of one pair of empty glumes, two neutral flowers, represented by two flowering glumes with distinct awns, and finally one perfect flower, of which the flowering glume and the palet are nearly uniform. We have, then, three flowering glumes in the same spikelet which do not resemble each other, a fact that has led to

*K. Goebel: Vergleichende Entwicklungsgeschichte der Pflanzenorgane (A Schenk's Handbuch der Botanik, Vol. III, p. 126, 1884.)

disagreement as to their true morphological identity. While several authors, as, for instance, Kunth, Nees-Von Esenbeck, Torrey, Roeper, Blytt, Hartman, Garcke, Lange, and others have adopted the same explanation as given above, and so strikingly characterized by Roeper* as "Eine Hierochloë, deren männliche Blumen auf die blossen Deckblätter reducirt sind," other authors have come to an entirely different conclusion. Döll† was unable to content himself and to believe that these three glumes, called flowering glumes by the other authors, should represent organs of the same morphological degree, when so different in shape; while otherwise, as for instance in *Bromus*, all the glumes show nearly the same structure. He therefore came to the conclusion that the fifth and sixth glume (the flowering glume and the palet of the perfect flower) represent the exterior wreath of a perigon, and that all the glumes are then situated on the same axis. This same explanation is also given by Eichler,‡ thus agreeing with Döll, who asserts that the flower is terminal on the rhachis, although he admits it to be contrary to the definition of most other authors.

Finally, Hackel§ has described *Anthoxanthum* as having four empty glumes, but does not mention whether the second pair, the inner ones, represents neutral flowers or not. It would be a very singular case, indeed, if the flower should really be terminal, although Döll's conclusion is very attractive. Schumann,‖ however, has not hesitated to give the same statement: "Ein Contaktkörper ist auch im auch im Abor nicht anzunehmen, die oberste Blüthe ist echt terminal (*Anthoxanthum*, *Hierochloa*)." But the same author seems not quite unwilling to change his idea, if only some "Missbildunzen" (*l. c.*, p. 131) might be produced, of which even Döll seems to have observed two cases.

In offering now a contribution to the explanation of the flowers of *Anthoxanthum*, the aim will be to show "that the two awned glumes inside the proper empty ones really belong to two neutral flowers," and "that the perfect flower has both a flowering glume and a palet, thereby not being terminal, but lateral." The material, which has served as a base for the present investigation, was collected in the Smithsonian park in this city. In regard to the locality where the specimens were collected the ground had lately been overflowed, so that in this fact the cause of the malformation might be found, especially since no other factors were observed, neither parasitic fungi nor insects.

The general appearance of the plants was quite remarkable; the culms were much taller than usual, the inflorescence very long, loose,

*Joh. Roeper: Zur Flora Mecklenburgs, 1844.

†Döll: Beiträge zur Pflanzenkunde. Mannheimer Jahresbericht, 1868.

‡A. W. Eichler: Blüthendiagramme, 1875.

§E. Hackel: The true Grasses, translated from "Die natürlichen Pflanzenfamilien" by F. Lamson Scribner and Effie Southworth, 1890.

‖Karl Schumann: Neue Untersuchungen über den Blüthenanschluss, Leipzig, 1890, p. 128, etc.

and nodding, while from the apical spikelets slender branches issued, terminated by a few, (1 to 4) small spikelets (Tab. XLVIII, Fig. 1). In some specimens the spikelets were transformed into leafy shoots, thus representing the well-known variety "vivipara," as described for many species of *Gramineæ* (Tab. XLVIII, Fig. 12).*

Now, concerning the first question, whether the two awned glumes represent two neutral flowers or not, let us examine figure 8 on the accompanying plate. This spikelet, of which the proper empty glumes have been removed, shows altogether three awned glumes, but of which only the two basal ones are now in question. They are both situated on the same rhachis, but at different heights, and we see farther that the uppermost one, that on the right side in the figure, partly encloses another smaller and awnless glume, which is a normal palet. Judging from the position and the shape of these two glumes in connection with the fact that one of them has been found enclosing a palet and flower, may we then not suggest that they both are true flowering glumes? There is no doubt that they correspond to the two similar glumes of the normal spikelet, because their position is exactly the same, and there is no essential difference in regard to their appearance; they were, it is true, merely hairy along the midrib, but this character is of but small importance. Several other variations were observed even in the same inflorescence, a circumstance probably due to the unusual moist locality where the plants were found growing. In some other spikelets, (Figs. 2, 9 and 10) only one of these glumes was developed, but it was easily recognized. We have now another case (Fig. 4) in which we see the same glumes again, but widely separated from each other on the same rhachis. Their form is here very different from the normal one, since they are distinctly acuminate and but shortly awned. We meet here a fact which shows that their form may not be constant, and also that they may resemble the proper empty glumes. This very abnormal case would have been a good support to Döll's theory that these glumes should not be equal to the fifth glume in the normal spikelet, since they are not only very different from this in regard to their shape, but in this case, they even resemble the empty glumes. We venture, however, to oppose this supposition of Döll by referring to the spikelet in Fig. 8. There are here three awned glumes, the uppermost one being a true flowering glume which has here simulated the shape of the others, and which really corresponds to the same glume of the normal perfect flower. It is situated upon the same rhachis as all the other glumes, the empty and the flowering ones of the neutral flowers, and encloses a palet and a rudimentary pistil, but no stamens. This was observed in several other spikelets, and we see it illustrated again in Fig. 6, where the uppermost flowering glume is easily distinguished by its long awn, although the glume itself is much smaller than the others.

*Compare E. H. Hunger: Ueber einige vivipare Pflanzen und die Erscheinung der Apogamie. Inaug. dissertation, Bautzen, 1887.

It may not be unreasonable to suppose now, that the spikelet of *Anthoxanthum* has three flowering glumes, although we have been unable so far to observe any trace of a palet or rhachilla in the axil of the lowest situated of these glumes.

We now want to reply to the next question and show whether the perfect flower, the uppermost one in the spikelet, is terminal, as stated by Döll, Eichler, and Schumann, or lateral. It is hardly necessary to offer any further discussion concerning this point, since it is a simple consequence of what has been shown in the two spikelets—Figs. 6 and 8; because we have seen in Fig. 8 that a palet is present, and thereby a rhachilla indicated, besides that in both figures the rhachis is distinctly elongated above the base of the flowering glume (Fig. 7), and shows here a pointed processus, as usual in the spikelets of the *Gramineæ*.

Although, as stated above, abnormally developed specimens have been used to demonstrate the morphological identity of the organs in the normal spikelet of *Anthoxanthum*, it may not be denied that the comparison seems to favor the generally adopted idea that the spikelet really contains three flowers, but of which only one is perfect, and that this same flower is not terminal but lateral. Before leaving the subject we will call attention to a very peculiar malformation observed in some of the examined specimens. An abnormally developed flowering glume of one of the neutral flowers (Fig. 11), the apex of which showed not only a long and strongly bent awn, but also on each side of this awn was an appendage, the structure and shape of which reminds one very much about the glume itself. We have then in this glume the same kind of prolification, of which similar cases have been recorded by Masters.*

The large number of truly viviparous spikelets examined did not show anything of particular interest; it might be noted that in these, as in all the other malformed spikelets, the empty glumes had constantly preserved their usual and normal appearance.

U. S. National Museum,
Washington, D. C., March 21, 1892.

EXPLANATION OF PLATE XLVIII.

Anthoxanthum odoratum L.

Fig. 1. Inflorescence with proliferous spikelets, natural size.

Fig. 2. Proliferous spikelet from the apex of the inflorescence, magnified about four times. The empty glumes are normally developed, while the flowering glumes of the neutral flowers are reduced to one; the rhachis is strongly elongated and bears at its apex three spikelets, the median nearly sessile, the two lateral ones distinctly pediceled, all surrounded by normal empty glumes.

Fig. 3. Spikelet *a* of the preceding, showing a normally developed spikelet with one pair of empty glumes, two awned flowering glumes of the neutral flowers, and a perfect flower with the flowering glume and palet of the same shape. c. 4 × natural size.

* Maxwell Masters: Vegetable Teratology, London, 1869.

Fig. 4. Proliferous spikelet from the base of the inflorescence, showing the two empty glumes, the two flowering glumes of the neutral flowers, which are here separated from each other and situated on an elongated rhachis. The apex of the rhachis bears a very rudimentary spikelet; the perfect flower is here represented by two small scales (flowering glume and palet) and a very rudimentary pistil with two stigmas. c. 4 × natural size.

Fig. 5. Branch with four spikelets from another inflorescence. c. 4 × natural size.

Fig. 6. Spikelet *b* of the preceding figure, showing the empty glumes, the flowering glumes of two neutral flowers, and a strongly elongated rhachis, which bears, a little below its apex, a rudimentary flower. c. 4 × natural size.

Fig. 7. The upper part of the rhachis of the preceding spikelet, showing the distinct, pointed apex of the rhachis, and a lateral flower, consisting of one stamen and one stigma; the palet is absent, but the flower is supported by a flowering glume with long awn. c. 15 × natural size.

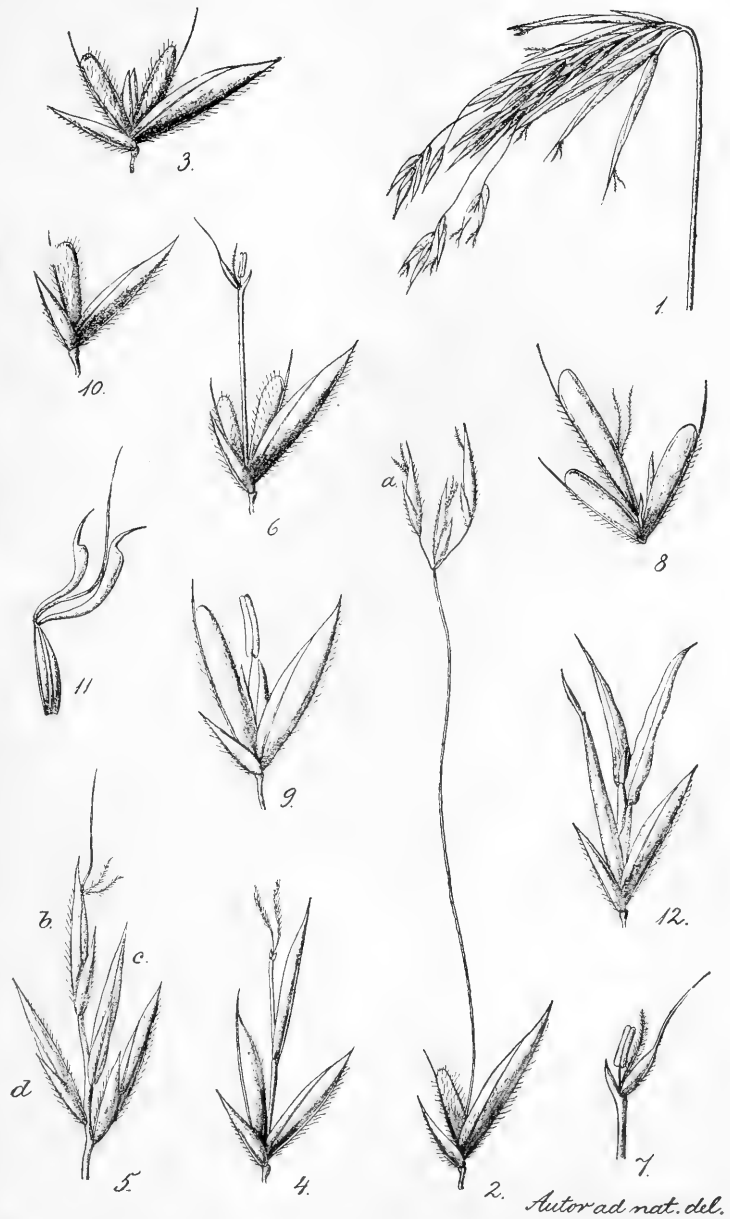
Fig. 8. Spikelet *c* from the inflorescence, shown in Fig. 5. The empty glumes have been removed to show the other parts more distinctly. There are here three distinct flowering glumes of about the same size and shape; the two lowest belong to the two neutral flowers, but of which the one at the right side in the figure encloses a palet. The rhachis is slightly elongated, and bears a third flowering glume, which also includes a palet and a rudimentary pistil, but no stamens. The rhachis is extended a little above the base of the uppermost flowering glume and is sharply pointed. This figure shows the lateral position of the perfect flower. c. 4 × natural size.

Fig. 9. Spikelet *d* of the inflorescence in Fig. 5. There is here, besides the two empty glumes, only one flowering glume of the neutral flowers; the other one is entirely wanting. The perfect flower has the flowering glume and the palet of the same shape as in normal spikelets, but only one stamen and no pistil. c. 4 × natural size.

Fig. 10. Spikelet from another inflorescence with but one flowering glume inside the pair of empty glumes. c. 4 × natural size.

Fig. 11. An abnormally developed flowering glume of a neutral flower, showing at its apex a long, bent awn and two glumaceous, awned appendages. c. 4 × natural size.

Fig. 12. A truly viviparous spikelet with normal empty glumes, while the other glumes have been transformed into green leaves. c. 4 × natural size.



ANTHOXANTHUM ODORATUM.

NOTES ON THE UNIONIDÆ OF FLORIDA AND THE SOUTHEASTERN STATES.

By Charles T. Simpson,
Aid in the Department of Mollusks, U. S. National Museum.

(With Plates xlix–lxxiv.)

INTRODUCTION.

For some years past I have made a special study of the *Unionidæ* of Florida and the southeastern States, their variation and distribution, and I have been led to prepare the following catalogue and notes principally for two reasons:

First. There are undoubtedly very many so-called species of unios from this region that are merely trifling variations of valid forms or actual synonyms, and which only serve to cumber our literature and embarass the student. Dr. Lea, our great authority, seemed in many instances to fully understand this wide variation, and he has often grouped together under a single name shells which at first sight seem to be distinct, but which, when carefully studied with other material, are seen to be but varieties of one thing. But in other cases he has founded species on trifling and inconstant characters, and has repeatedly given different names to what are evidently identical forms.

More recently the Wrights (Messrs. S. H. and B. H.) have collected in the lake region of Florida, they have made a study of the *Unionidæ* of the State, and have published quite a number of new species; but they do not appear to have worked up their material with sufficient thoroughness, as a number of their new unios are certainly varieties of well-known forms or actual synonyms of hitherto named species from Georgia, Florida, and the Carolinas.

Secondly. Much confusion exists among collectors and students regarding the material in their collections, a considerable proportion of the shells from this region having been sent out under wrong names. Fully one-half these species are not understood, and the cabinets of conchologists in general exhibit the most deplorable confusion in this matter.

It is my desire in this list to considerably reduce the number of so-called species by showing that they vary into each other, or that many of them have without proper study simply been assumed to be new and renamed, and to give such descriptions and notes as will materially assist in properly determining material.

Little is known regarding the variation and distribution of the mollusks of this region, as but a very small part of it has been explored. No doubt many allied forms, which from want of sufficient material I have not felt justified in reducing to synonymy, will have to be united when we have thoroughly worked up the mollusks of all the southeastern States, and there are probably some valid species as yet undescribed. Perhaps my opportunities for studying the *Unionidæ* of this region are as good as can be had at the present time. I resided four years in southwest Florida, and the collection I made at that time is very nearly complete as to species. I have had for study all the material belonging to my friend the Rev. A. Dean, of Muncy, Pa.; the magnificent set of southeastern unios belonging to Mrs. George Andrews, of Knoxville, Tenn., including the shells collected by F. Rugel; the equally complete lot of material in the cabinet of Mr. William A. Marsh, of Aledo, Ill., who owns the finest private collection of these shells in existence, and who has greatly aided me in my work with numerous valuable notes and suggestions. In the National Museum I have had constant access to our general collection, most of which has been studied and named by Dr. Lewis and Mr. R. E. Call. This includes a large and nearly complete series of Mr. Wright's new species, donated to the Museum by that gentleman. Besides this there is the unequaled collection of Dr. Lea, which includes most of the types from this region and a large number of valuable duplicates, as well as most of Dr. Gould's species, which were sent by their author to Dr. Lea.

A few words may not be out of place concerning the distribution of the *Unionidæ* in the United States. There are two tolerably well defined areas of distribution in northern North America which contain very distinct assemblages of species, and each of these has a subregion peopled to some extent with different but allied forms.

First. The Mississippi drainage area, embracing a territory of 1,250,000 square miles. Within this region the *Unionidæ* attain a finer development than in any other part of the world, not only in the number of species, but in the magnificence of their forms and the perfection of individual specimens. It is here, where the streams flow over vast beds of limestone and where food is abundant, that the conditions for unio life are most favorable and nature has fairly reveled in the creation of the beautiful, the ponderous, and the grotesque. Here the genera *Unio* and *Margaritana* assume a variety of forms that are odd and strange; here are developed species with winged hinges, strong corrugations, knobs, and sinuses.

South and west of this, in the streams running mostly through Texas and the eastern slope of Mexico into the Gulf, is found a small assemblage of forms not met with in the Mississippi Valley, though closely related to the species found in that region. They have for the most part finely developed shells, and their relationship to those of the area just mentioned and the fact that many of the species of the great

valley are found in Texas and Mexico lead me to consider this merely a subregion.

Second. From the mouth of the Mississippi, extending to the southern extremity of Florida, northward into the British possessions, and again westward to include all the St. Lawrence drainage, and embracing all the streams in this territory that fall into the Atlantic and the Gulf of Mexico, there is found a set of *Unionidæ* possessing very different characters from those of the area first mentioned. Here the species, as a rule, are moderate in size and neutral in color, and but few odd or striking forms are found; though *Unio spinosus* and *U. collinus*, the only shells known bearing true spines, belong here. The change in forms from Nova Scotia to Florida is very slight; in fact some groups, such as that of *Unio complanatus*, extend throughout the whole region, and if they can be said to break into good species, the variation is certainly very gradual and specific lines are very difficult to determine. Quite a number of forms seem to be confined to the State of Florida, though, perhaps, when we have a thorough knowledge of their distribution, we shall find their range much extended. It is probable that the State was peopled with *Unionidæ* from the region just north and west of it; that here has been a migration as the land arose from the Appalachian chain southward and eastward. The fact that the Florida species differ from those of southern Georgia, Alabama, and the lowlands of the Carolinas is due, perhaps, to a milder climate, and to some extent, no doubt, to the existence of a remarkable system of small clear lakes in the former State, in which the *Unionidæ* have attained a high state of development.

In the vicinity of the mouth of the Mississippi and for some distance along the territory just north of the Gulf there is a mingling of forms of the two areas, and the same thing is again seen in the region of the Great Lakes, while in the middle ground the Appalachian chain has acted as a much more effective barrier between the species.

There is but a very limited development of the *Unionidæ* throughout the Rocky Mountain region and the Pacific slope; a couple of species of unios, *Margaritana margaritifera*, and three or four anodontas. Several so-called species of west coast anodons of the group of *A. Californiensis* are considered by Dr. Stearns (who perhaps has a better knowledge of the mollusk fauna of western America than any other man living) mere local races of *A. cygnea*, of Europe, a form which he believes to be circumboreal. (See paper on History and Distribution of the Fresh Water Mussels, and the identity of certain alleged species, Proc. Cal. Acad. Nat. Sci., Nov. 20, 1882.) In this opinion I am inclined to concur. *Ano. angulata*, so different normally, is shown by photographs from specimens made by that indefatigable collector, Mr. Henry Hemphill, as well as by material in the National Museum, to be very closely related to the species I have mentioned. The two unios are not strongly characterized, but show evident relationship to the species of the Atlantic drainage. I believe the *Unionidæ* of this region

to be much more intimately connected with those of the Atlantic system than the Mississippi valley, and I consider this a subregion of the former. Perhaps in the whole United States not over one hundred valid species will be found to be extra limital. It is worthy of note that while these areas seem to confine the *Unionidæ* within given bounds, they present no perceptible barriers to the *Corbiculidæ* or the fresh-water univalves which are everywhere found with them.

Lea's arrangement of the *Unionidæ* in two great divisions—symphynote and non-symphynote; the former including those species in which the dorsal margin is more or less produced into a wing, the latter those without it—and the subdivision of these groups into smaller ones, first on peculiarities of sculpture, and secondly according to form, is a simple, comprehensive one, but it is an arrangement which is certainly artificial and not in accordance with all the facts of nature. We often find shells which are entirely destitute of the dorsal wing, which by sculpture, form, texture, and general characters are evidently closely related to those which are symphynote, and there is even the greatest possible variation in this character in the individuals of the same species. Lea himself acknowledged that this character was of little value in classification. The same species may be either absolutely smooth or strongly pustulate, as in *Unio infucatus*, or *U. pustulosus*, which, in the variety *Schoolcrafti*, is often entirely destitute of nodules; it may be strongly sulcate or entirely plain, as *U. negatus*, a shell with well-marked concentric ridges, which graduates imperceptably into *U. rubiginosus*, a perfectly plain form; and *U. Estabrookianus*, *stramineus* and others exhibit precisely the same variations. So far as form goes as a character by which to classify, Mr. Lea has, in order to conform to it, been obliged to widely separate members of such well-characterized groups as those of *U. Buckleyi*, *U. complanatus*, and *U. luteolus*.

In arranging I have attempted to place the species in natural groups, putting those together as far as possible which seem to have a more intimate relationship, and which have probably sprung from a common ancestry at a recent date, and yet doing as little violence as possible to Mr. Lea's general arrangement. I am aware that these groups are not as a rule of great importance, that they often imperceptibly merge into others, and that any lineal arrangement of them must be artificial, as many of them show about equal relationship to several others. In grouping, sculpture, form, color of epidermis and nacre, the teeth, general facies, and texture, as well as locality, have all been taken into consideration.

I have for the most part given a set of outlines drawn from the valves of the shells, to illustrate the form and variation and to assist in the determination of the species. In a paper like this the cost of figuring so large a number of forms would be too great, and it is believed that these outlines, often drawn from the type-shells, which I have found very useful when sent to students, will prove a great aid in comparing with specimens, giving an accurate idea of dimensions and form. I

have attempted to indicate in the text the degree of inflation, sculpture, character of epidermis, and color pattern, character of teeth, nacre, and other points of interest.

I have followed Mr. Lea in the terms used in measurement and designation of parts of the shell, calling that part of it which is in the advance when the animal is traveling the anterior, and the opposite end, which bears the ligament, the posterior. The distance from the anterior to the posterior margins Mr. Lea calls the breadth or width; that from the base or ventral region to the beaks the length. I prefer the arrangement of Broderip and Sowerby, which is followed by Conrad and other American conchologists, of terming the distance from the forward to the hinder part of the shell the length, and that from the umbones to the base the height or width, but have thought it perhaps best to use the terms of our great authority on the *Unionidæ*.

I have only described such species as to my knowledge have been collected in the State of Florida, as it was necessary to fix some limit to the list. Many other species, however, are noticed in outlining the groups to which the Florida shells belong.

There are no doubt errors in the work I have undertaken, since much of this is a matter of judgment, and human judgment is liable to error in the determination and arrangement of many of these exceedingly close and puzzling forms. My aim has been to reduce to order the chaos in which I found our southeastern *Unionidæ*, and throw some light on the limits of the species, their relationships, and distribution.

GENUS UNIO.

GROUP OF UNIO INFUCATUS.

The species which typifies this group seems to stand alone among American unios. *U. corrugatus* of India resembles it somewhat in sculpture and general form, but is more inflated and has a less solid hinge. *U. infucatus* in general form is very close to *U. lenticularis* and *U. chickasawhensis*, but is characterized by peculiar chevron-shaped and more or less nodulous corrugations, in some cases covering the entire shell. The former species varies greatly in the amount of sculpture, even to specimens which are nearly smooth, much as *U. pustulosus* varies into the smooth forms of *Schoolcrafti*, and it is possible that the present group should be merged with that of *U. chickasawhensis*.* The general form is lenticular, the color dark brown to black, the teeth and hinge plate rather solid, with nacre varying from white to lurid purplish.

Unio infucatus Con.

Unio infucatus Con. (Plate XLIX. Figs. 1, 2, 5.) New F. W. Shells, pl. III, fig. 2. *Unio Kleinianus* Lea. (Plate XLIX. Fig. 6.) Obs. V, p. 21, pl. XVII, fig. 18, Mar. 5, 1852. Type, Suwanee R., Fla., collected by Maj. Le Conte, West Florida; coll. of Wm. A. Marsh.

*Since writing the above the examination of a large amount of additional material has convinced me that this species groups with *U. chickasawhensis*.

Lea attempts to separate his species from Conrad's on the ground that the latter is not figured as a folded shell; that his differs in having larger plications, which are more interrupted, and in the color of the epidermis, which in *infucatus* when old is quite black. Yet in his own collection some of the specimens of *Kleinianus* are nearly without sculpture, and others are almost jet black, while those of *infucatus* vary from almost absolutely smooth to strongly corrugated throughout. Among hundreds of duplicates in the Lea collection from many localities I find every gradation, from inflated forms having a well-marked posterior ridge to those which are lenticular; the sculpture varying from absolutely smooth to completely corrugated, and a range of color from shining black to fulvous, and even green on young specimens.

So far as I know the species is confined to the waters of Georgia and northern Florida.

GROUP OF UNIO CRASSIDENS.

Mostly solid triangular shells, with heavy epidermis, and a prominent ridge running from the beaks to the posterior ventral region, the posterior slope of which is usually slightly folded, with nacre varying from white to salmon and purple.

U. crassidens, an abundant species in the Mississippi drainage basin, is one of the largest and most ponderous of Unios. The other species are distributed through the southeastern States.

Unio Forbesianus Lea.

(Plates XLIX, Fig. 3, Plate L, Figs. 2, 3.)

Unio Forbesianus Lea. Obs. V, p. 20, Pl. XVI, Fig. 17, Mar. 5, 1852. Type, Savannah R.
Unio Moussonianus Lea. (Plate L, Fig. 4.) Obs. V, p. 24, Pl. XVIII, Fig. 22, Mar. 5, 1852. Type, Georgia; Barrett.
Unio vestitus Lea. (Plate XLIX, Fig. 3; Pl. L, Fig. 1.) Obs. IX, p. 11, Pl. XXV, Fig. 259, Dec. 24, 1861. Ogeechee R., Ga.; Le Conte and Anthony.

U. Forbesianus and *vestitus* were described from young specimens, and in a careful examination of the types in Lea's collection, as well as that of *U. Moussonianus*, I can not see any difference worthy of even varietal names. These shells bear considerable resemblance to the well known and abundant *U. crassidens*, but are less solid and do not attain the size of that species. *U. Forbesianus* has been collected by F. Rugel in Lake Monroe and Black Creek, Florida; these specimens, which now belong to Mrs. George Andrews, having been compared by the writer with Lea's types.

Unio monroensis Lea.

(Plate LI, Fig. 1.)

Unio monroensis Lea. Obs. IV, p. 37, Pl. XLI, Fig. 8, Aug. 18, 1843. Type, Lake Monroe, Fla., collected by Dr. Budd.

U. monroensis is very close to the last species, differing from it only in being slightly less solid, in having more compressed teeth, and in

being rather higher colored. I think it quite probable that when large series of this are compared with *U. Forbesianus* they will be found to be mere variations of one species.

Unio pusillus Lea.

(Plate LI, Figs. 2, 6.)

Unio pusillus Lea. Obs. IX, p. 19, Pl. XXVII, Fig. 36, Oct. 2, 1840. Ogeechee R., Ga.; Maj. Le Conte.

Unio buxeus Lea. (Plate LI, Fig. 3.) Obs. V, p. 17, Pl. XV, Fig. 13, Mar. 5, 1852. Abbeville Dist., S. C.; J. P. Barrett.

Unio Anthonyi Lea. (Plate LI, Figs. 4, 5.) Obs. IX, p. 19, Pl. XXVII, Fig. 266, Feb. 5, 1861. Fla.; Anthony.

Dr. Lea described *U. pusillus* from specimens he had long thought the young of some other known species. *U. buxeus* was described from three shells, only one of which he considered adult. I do not see how it is possible to separate these from the types of *pusillus*, as they agree in size, form, color of epidermis and nacre, and in the teeth, and all appear to me to be young shells. His type of *U. Anthonyi*, a single specimen, probably adult, had been varnished and otherwise injured. It is a tawny yellowish green, with very faint rays, and is hardly as solid a shell as some of the young of *buxeus* and *pusillus*. A young specimen of *U. Anthonyi* which Mr. Lea afterwards obtained of Maj. Le Conte, from the Ogeechee River, is quite conspicuously rayed, and is almost precisely like some of the specimens of the above named species.

Unio dorsatus Lea.

(Plate LI, Fig. 7, Plate LII, Figs. 1, 2.)

Unio dorsatus Lea. Obs. XII, p. 60, Pl. XLV, Fig. 112, June 2, 1868. Type, Catawba R., N. C.; C. M. Wheatley.

A very variable and puzzling species. There is much difference in the solidity, width, and form of individuals. A specimen is before me from the cabinet of Wm. A. Marsh, labeled "*U. Anthonyi* Lea, Florida," and another from Mrs. Andrews, collected in Florida, by Rugel, without locality, which are, I believe, *U. dorsatus*. In all the examples I have seen, the epidermis is dull tawny brownish and squamose, the substance of the shell rather thin, and the nacre shaded purple. The form of the shell, its dorsal ridge, and the slight plications of the posterior slope probably place it here, but it has affinities with the *Complanatus* group.

GROUP OF UNIO COMPLANATUS.

Unio complanatus, which is one of the most abundant species in the United States, may be taken as the type of an extensive group which is distributed from Canada to northern Florida, and from the Appalachian Chain to the Atlantic. Mr. Lea recognized the immense varia-

tion of this species, as is shown in his collection, where the most diverse forms from Canada, New England and the Middle States are placed by him under the name of *U. complanatus*. But he seems to have fixed its southern limit with some rare exceptions somewhere about the State of Virginia, and has applied specific names to every variation found south of that. One can almost exactly duplicate in his immense series of *complanatus* such forms as *roanoakensis*, *savannahensis*, *Postellii*, *neusensis*, *Hallenbeckii*, *napeanenssi*, *hopetonensis*, and a dozen others, and the conviction becomes strong with any one who attempts to study or name the members of this puzzling group that if the diversified forms in the more northern States are mere variations of one species, most of those in the South are nothing more. There is an immense amount of this material, numbering thousands of specimens, in Dr. Lea's collection and among his duplicates, contributed largely by Dr. Emmons, C. M. Wheatley, Girard Hallenbeck, Dr. Lewis, J. Postell, Bishop Elliott, and Dr. Barrett. The accompanying notes, the names written on the shells and erased, and the controversies among these earnest students of a past generation concerning their proper identification, show how hopeless was the task of attempting to satisfactorily determine these varying and puzzling forms.

It may be said in general terms that the species of the group are wide and rhomboidal, with usually a well developed posterior ridge, are somewhat compressed, with an epidermis varying from smooth and shining to squamose, and in color range from tawny yellow through greenish to black, either with or without rays. The nacre is not often iridescent, and varies from white or yellowish to deep purple.

Unio hopetonensis Lea.

(Plate LII, Fig. 3, Plate LIII, Fig. 1.)

Unio hopetonensis Lea. Obs. II, p. 29, Pl. IX., Fig. 24, Feb. 5, 1836. Hopeton, Ga.; Prof. Shepard.

Dr. Lea described this species from a young individual (diameter, 9; length, 1.7; breadth, 3.4 inches), which but imperfectly showed the characters of the adult shell. I have been strongly tempted to place *Unio dariensis* in the synonomy, for though selected specimens of the latter differ in a marked degree from the former, yet among the large amount of material that has passed under my hands there are examples which may as well be placed with the one as the other. The species is one of the largest found in the southeastern States, often attaining a length of 3 inches, a width of 5½, and a diameter of 2 inches. As a rule it is a smoother shell than the allied species, is less inflated, and has not so decided a posterior ridge.

Unio dariensis Lea.

(Plate LIII, Fig. 2, Plate LIV, Fig. 1.)

Unio dariensis Lea, Obs. III, p. 84, Pl. XXVI, Fig. 61, Oct. 21, 1842. Darien, Ga.; J. H. Couper.

Some of the specimens of this species are so greatly inflated and possess such a strong posterior ridge that they would seem to belong to the *crassidens* group, and from these there is every gradation to forms which would undoubtedly be placed with *U. complanatus*. The nacre varies from silvery to dark purple, and the cardinals from compressed to transverse. A young shell which I refer to this species, labeled "Florida," and belonging to Mrs. Andrews, is before me. This and the allied species, so far as I know, have only been reported from Georgia.

GROUP OF UNIO SPISSUS.

In form the shells which I have placed in this small group are related to *U. ochraceus* and the species which belong with it, but they differ in being wider, and in having the epidermis and nacre more like that of *obesus*. *U. splendidus* has the form of *Downiei*, *spissus*, *geminus*, and the rest of the group, but in coloring approaches *ochraceus*. This assemblage seems to naturally include a few species ranging from North Carolina to Florida, among which *U. Downiei* has been obtained at several localities in the latter State. *U. borealis* Gray, of Canada, though perhaps a small form of *luteolus*, closely resembles in shape some of the species which belong here.

Unio Downiei Lea.

(Plate IV, Figs. 1-3, Plate LVI, Fig. 5.)

Unio Downiei Lea, Obs. VII, p. 28, Pl. XXV, Fig. 91, July 6, 1858. Buck Lake, Satilla River, Ga.; T. C. Downie and J. Postell.

A fine species, of which the Lea collection contains numerous examples from various localities. The Georgia specimens are quite solid and inflated, with a peculiar lurid nacre, having a tint of purple something like that of *Unio Jewettii*.

Eight specimens of a unio from several localities in Florida are before me, which have been a veritable stumbling block to students and over which I have been greatly puzzled. Some of them have been received as *U. Anthonyi*, but they are not at all like that species in any respect. Others have been labeled *U. Hinkleyi* by collectors, and there is some resemblance in all of them to *U. monroensis*. One of these, belonging to Mrs. Andrews and collected by F. Rugel, in Florida, is as large as any of Lea's specimens of *Downiei*, but is thinner and wider and has a more purplish nacre. From this there is an unbroken series down to what seem to be adult shells not quite 1½ inches in length and 2½ in width, which are rather thin, are not greatly inflated, and have the nacre strongly violet tinted. I had thought some of these must be

an undescribed species, but as the form throughout is more like *U. Downiei* than any shell I know of, and as there is a complete series connecting with that species, I believe them to be but a southern form of the Georgia shell. In all of them the ventral outline is considerably inflated, though sometimes slightly constricted nearly opposite the beaks; there is more or less of a posterior ridge; the dorsal region is full; the anterior cicatrices deep, and the nacre is rather dull colored. Three of these specimens, which are among the smallest and farthest removed from the type, were sent from Lake Woodruff, Florida, by Berlin H. Wright, and labeled by him *U. Anthonyi*. Another from the same lake, in Mrs. Andrews' collection, though of small size, approaches nearer to Dr. Lea's shells from Georgia and South Carolina.

GROUP OF UNIO MODIOLIFORMIS.

This assemblage of unios, which contains quite a number of nominal species, ranges from North Carolina to Tennessee, west, perhaps, to Mississippi, and south to middle Florida. The group consists of oblong shells, rather thin in structure, more or less inflated, and rounded before and behind; varying from tawny yellow or brown to greenish, and always more or less rayed, often beautifully so. They approach the *parvus* group in some characters, but are larger, rather wider, and usually thinner in structure, but often have the same brilliantly iridescent nacre. The line is not very distinct between these species and the group of *nashvillensis*. The latter are usually solider shells, have often reddish or lurid and rarely iridescent nacre, and are more pointed at the posterior end, which is usually somewhat angulated in outline. Individuals are very numerous, and as a consequence the species are quite variable.

Unio modioliformis Lea.

(Plate LVI, Figs. 2, 3, 6.)

Unio modioliformis Lea, Obs. I, p. 209, Pl. XIII, Fig. 40, Feb. 7, 1834. Santee Canal, South Carolina; Ravenel.

Unio exiguus Lea (Plate LVI, Fig. 1), Obs. III, p. 29, Pl. VII, Fig. 1. Dec. 1, 1838. Chattahoochee River, Columbus, Ga; Dr. Boykin.

Unio nigrinus Lea (Plate LVI, Fig. 4), Obs. V, p. 40, Pl. XXIV, Fig. 44. March 5, 1852. West Florida; Maj. Le Conte.

Unio rutilans Lea (Plate LVII, Figs. 2–5), Obs. VI, p. 59, Pl. IX, Fig. 41. Nov. 4, 1856. Othcalooga Creek and Columbus, Ga; Bishop Elliott.

Unio subellipsis Lea (Plate LVII, Fig. 1), Obs. VI, p. 62, Pl. X, Fig. 44. Nov. 4, 1856. Creeks near Columbus, Ga.; Bishop Elliott.

Unio Averillii B. H. Wright (Plate LVII, Fig 6), Proc. Acad. Nat. Sci., Phila., 1888, p. 115, Pl. III, Fig. 2. Lake Ashby, Volusia County, Fla.

A handsome, widely-distributed, abundant, and very variable species. It ranges north to North Carolina, south to central Florida, and I found it among Lea's duplicates, with shells sent by Spillman, said to be from Columbus, Miss. Lea described *U. modioliformis* from a fully adult female specimen, which accounts for the spreading out of the posterior

part of the shell of which he speaks. A fine male example belonging with the type exhibits almost nothing of this expansion. Four of his specimens are rather more inflated than anything I have seen of the other species I have placed in the synonomy, though scarcely more so than some *subellipsis*, while other examples which Mr. Lea has placed with this species can not be distinguished from *rutilans* or *exiguus*. As a rule, *exiguus*, which was described from a young specimen, is not quite so wide as *rutilans*, but there is in the material I have examined every possible variation in width.

U. subellipsis is generally somewhat solider than the other forms, but there is every grade in Lea's suite, to shells of the most fragile character. In Florida the species seems to become smaller, the epidermis is often a tawny or brownish color, slightly rayed, and the shells are hardly so wide as the typical *rutilans* or *modioliformis*. One such a specimen, which is unusually dark, Dr. Lea named *U. nigrinus*, but on holding it up to the light it is seen to be distinctly rayed with green and yellow. *U. Averilli* is the same thing, but more brilliant in color. The Florida form is quite commonly sent out as *U. floridensis* Lea, the latter being the thin southern form of *U. anodontoides*, and an entirely different thing. I have examined many hundreds of specimens of these shells from various localities in the Carolinas, Georgia, Florida, Alabama, and Mississippi, and I feel certain that I am right in uniting all these under one species. I have before me examples from Lake Ashby, Florida, collected by B. H. Wright, and sent by him to the National Museum as *U. Averillii;* Lea's type of *nigrinus* from West Florida; shells from St. Augustine, collected by C. W. Johnson, and from numerous other localities in the State, and they are certainly all forms of the more northern species.

ROUP OF UNIO SUBANGULATUS.

Unio subangulatus is a peculiar shell, rather wide-oval in outline, and brilliantly rayed with blackish green on a yellow or straw-colored ground. The posterior portion in adults is often much produced and quite pointed; the ventral region is very full, and the shell usually considerably inflated. It is placed with *U. sparus* and *scitulus* by Dr. Lea and probably groups with them; though they have the peculiarities I have noticed much less developed. They inhabit Tennessee, Alabama, Georgia, and Florida.

Unio subangulatus Lea.

(Plate LVIII, Fig. 1.)

Unio subangulatus Lea, Obs. III, p. 47, Pl. XIII, Fig. 23, Oct. 2, 1840. Chattahoochee River Columbus, Ga.; Dr. Boykin.

Lea's types were young shells, as the one he figures is but 1 inch in length and 1.7 inches in width, and do not show the great ventral inflation nor the development of the posterior point as older specimens do. The

cardinal teeth are rather compressed, the laterals straight, and suddenly truncated at the posterior end; the nacre varies from silvery white to salmon red, and when colored shows through the epidermis, and is often beautifully iridescent. One of Lea's specimens measures nearly 3 inches in width by $1\frac{3}{4}$ in length. A magnificent specimen is before me from the cabinet of Mrs. Andrews, collected by F. Rugel, and by him labeled "*U. radians*, Lea, Othcalooga River, Florida," which nearly equals Lea's largest specimen in dimensions, and is elegantly and distinctly rayed.

GROUP OF UNIO NASHVILLENSIS.

A widespread group represented by many species, ranging from North Carolina to Iowa, and south to Texas and Florida. The species vary from oblong to wide, are usually rather thin in structure, the posterior end is generally pointed, and more or less angulated in outline, and the posterior ventral region is always well developed in the females, sometimes greatly so. The general outline of the shells is much like that of the *luteolus group*, but they are smaller, less solid, and often have dark nacre, varying from lurid reddish to deep purple. With few exceptions the epidermis is rayed.

Unio concestator Lea.

(Plate LVIII, Figs. 2, 3, 4.)

Unio concestator Lea, Obs. VI, p. 66, Pl. XII, Fig. 48, Feb. 17, 1857. Creeks near Columbus, Ga.; Bishop Elliott.

I have only seen a single specimen of this species from Florida, which belongs to the Rev. A. Dean, of Muncy, Pa., and was collected in Lake Harris by Mr. Wright. It is a female, strongly developed in the posterior ventral region, with silvery iridescent nacre, and dark ash-colored epidermis varying to yellowish and greenish and slightly rayed. It does not agree in color with any specimen of *concestator* I have seen, but does in general form, and is probably an extreme variety. At any rate I do not care to found a species on a single specimen possessing no stronger distinctions than mere color markings. It is not very different from some of the specimens I have seen of *nashvillensis*, but the distribution of *concestator* is southeastern, while the former is found in the central Southern States. It is probable that a number of the species of this group, such as *fallax*, *nashvillensis*, *lienosus*, and the one under consideration, as well as some others, are merely varying forms of one and the same thing.

Unio tenerus Rav.

(Plate LVIII, Figs. 5, 8.)

Unio tenerus Rav., Ravenel's catalogue, p. ——, 1834.

Several specimens of this species are in the collection of Mrs. George Andrews, labeled "Florida," without locality. It is close to *nash-*

villensis in form, but differs in being quite thin and having a yellowish ground quite strongly rayed with dark green. It is found in Georgia.

GROUP OF UNIO BUCKLEYI.

Unio Buckleyi may be taken as the type of a very extensive group, distributed along that part of the Atlantic slope from North Carolina to south Florida. The shells are oval to oblong in outline, generally rounded before and behind, with rarely a conspicuous posterior ridge, and usually shining epidermis, varying from yellowish to chestnut or black, often greenish and beautifully rayed, especially in young specimens, but sometimes becoming squamose or lamellated and dull-colored when old.

The teeth vary from thin and compressed to quite solid; the nacre is generally brilliant, and varies from silvery white to coppery or deep purple. In a number of species of this group, as in that of *obesus*, the old shells become greatly developed at the posterior ventral point, so that the ventral outline is either straight or arcuate. There is a tendency in some of the more compressed forms to biangulation in the posterior region.

Unio Buckleyi, Lea.

(Plate LVIII, Figs. 6, 7; Plate LIX, Figs. 1, 2; Plate LX, Fig. 2.)

Unio Buckleyi Lea, Obs. IV, p. 34, Pl. XXXIX, Fig. 2, Aug. 18, 1843. Lakes Monroe and George; S. B. Buckley.

Unio Buddianus Lea (Plate LX, Figs. 3, 4), Obs. IV, p. 35, Pl. XL, Fig. 5, Aug. 18, 1843. Lakes Monroe and George; S. B. Buckley.

Unio Dorei B. H. Wright (Plate LXI, Fig. 3), Proc. Acad. Nat. Sci., Phila., 1888, p. 115, Pl. III, Fig. 1. Lake Monroe; B. H. Wright.

Unio Simpsoni B. H. Wright (Plate LIX, Fig. 3; Plate LX, Fig. 1), Proc. Acad. Nat. Sci., Phila., 1888, p. 117, Pl. V, Fig. 1. Lake Woodruff, Volusia County.

Unio Dalli B. H. Wright (Plate LXI, Fig. 2), Proc. Acad. Nat. Sci., Phila., 1888, p. 119, Pl. VI, Fig. 1. Lake Beresford, Volusia County.

Unio Orcuttii S. Hart Wright (Plate LXI, Fig. 1), West Am. Scientist, Vol. IV, No. 36, p. 60.

A protean species, very abundant throughout the greater portion of the State of Florida. Lea's figured type represents a fully adult shell, and one that may be considered a fair average of the form under consideration. Mr. Lea says in his description:

A number of specimens are before me, and they present many different forms, differing in many respects, as the varieties of the *U. complanatus* do from each other. The prevailing color of the nacre, which is very brilliant, is salmon, but many are purple; two only are white. The epidermis of all the older specimens is dark-brown, some are nearly black and without rays; the younger are smooth and polished on the outside, with numerous obscure green rays, larger on the posterior slope. The general outline of most specimens is like that of *U. batavus* (Lam.), but some individuals approximate to that of *Unio ovalis* (Flem.).

There can be no doubt on examining the Lea series that he had a very good knowledge of the wonderful variation of this species. It

ranges from oval to arcuate, and there is a considerable amount of difference in the degree of inflation. Some individuals, which are apparently adult, are thin, and consequently have compressed teeth; others are quite ponderous with transverse cardinals. The epidermis is not always dark in adult specimens, as has been stated by Dr. Lea, for I have before me a tray containing four examples belonging to Mrs. Andrews, collected by F. Rugel in Black Creek, the largest of which is 2 inches in length by 3 in width, and is quite smooth, a *tawny yellow faintly rayed*, and having a brilliant coppery violet nacre. One of these shells, fully adult, is a *bright green, with yellowish rays;* the others are *bronzy green.* These specimens passed under the inspection of Mr. S. H. Wright, and were labeled by him *Unio Websteri*, but I believe that species to be merely a form of *U. obesus.*

Throughout the lake region *Unio Buckleyi* seems to attain its highest development, and is often highly colored externally with yellow, salmon, coppery, bronze, or green, and the nacre is sometimes dazzlingly bright. *U. Simpsoni*, from Mr. Wright's figure and description, appears to be one of these forms. I can tell but little about it from the specimens sent out. Four shells in Mrs. Andrews' collection from Lake Monroe, to which he has given this name, are young *Jayanus*, and another lot of three adults to which he has given the same name are adults of the last-named species, and are *exactly typical.* Three other *Simpsoni* (according to Mr. Wright) in this collection from the same lake are *U. aheneus*, and specimens he has sent to Mr. Marsh, and others to the writer, are certainly *Buckleyi.*

U. Buddianus differs in no character from the species under consideration, and I can not understand why Mr. Lea should have named it, as he described the two at the same time. Part of his *Buddianus* are placed in his collection with *Buckleyi* and *occultus*, the remainder near *orphaensis* and *symmetricus*, several hundred numbers farther on. *U. Dorei* seems to be only a synonym, by Mr. Wright's figure and description, and three specimens before me belonging to Mrs. Andrews, which he has so labeled, are Simon-pure *Buckleyi. U. Orcuttii*, of which the writer sent Mr. Wright examples from Myakka Lakes, Manatee County, is exactly like some of Lea's typical shells. *U. Dalli*, from description, figure, and specimens which Mr. Wright has sent the Museum (Museum No. 91126) and others he has labeled in Mrs. Andrews' collection, appears to be a depauperate *Buckleyi.*

All the shells I have seen of the last-named species are eroded, or have very dirty black epidermis; the nacre is dull, lurid, purplish, and blotched, and they are evidently diseased. *U. Whiteianus* Lea, from the Savannah River, is doubtfully distinct.

Unio Jayanus Lea.

(Plate LXI, Fig. 4).

Unio Jayanus Lea, Obs. II., p. 28, Pl. IX. Fig. 23, Feb. 5, 1836, Florida; Dr. Jay.
Unio Marshi, B. H. Wright (Plate LXII, Fig. 2), Proc. Acad. Nat. Sci., Phila., 1888, p. 118, Pl. V, Fig. 2; Lake Woodruff, Volusia Co.
Unio Tryoni, B. H. Wright (Plate LXII, Fig. 1), Proc. Acad. Nat. Sci., Phila. 1888, p. 120, Pl. VI, Fig. 2, Lake Woodruff.

Lea described this species from single opposed valves of two individuals. At the present time there are in this collection a single normal pair about half grown, and an adult right valve, neither of which is the specimen he has figured. This species is very closely related to *U. Buckleyi*, so much so that it is often difficult to separate it, especially the young, yet Mr. Lea has placed it with *aheneus*, and *Emmonsi*, in the *Fisherianus* group, a long way from the former. In general terms it may be said to be wider, thinner, more attenuated at the posterior point, and more inflated at the ventral region, than that species. The form which Mr. Wright has called *Unio Marshi* is no doubt a synonym. I have examined a specimen in the possession of Mr. Marsh, who received it from Mr. Wright, and by whom it was so labeled, and it is certainly *Jayanus*. *U. Tryoni* is only a rather wide, large form of the species under consideration, having usually a blackish, rough epidermis. Five specimens are in the Museum collection (Museum No. 91129), received from Mr. B. H. Wright, and collected in Lake Woodruff, labeled by him *Unio woodruffensis* Wright, and afterwards changed to *Unio Tryoni* Wright, which are typical *Jayanus* and are identical with two specimens he has sent the Museum (Museum No. 91144) from Lake Beresford, to which he has given the latter name. Nor do they differ materially from eight specimens he has sent the Museum (Museum No. 91141) labeled *Unio leonensis* Wright, Lake Woodruff, near De Leon Springs. (Plate LXII, Figs. 3, 4).

Unio coruscus Gould.

(Plate LXIII, Figs. 1, 7.)

Unio coruscus Gould, Proc. Bost. Nat. Hist. Soc., Vol. VI, p. 15.
Unio Fryanus. B. H. Wright. (Plate LXIII, Fig. 3.) Proc. Acad. Nat. Sci. Phila., 1888, p. 113, Pl. II, Fig. 1. Lake Ashby, Volusia County, Fla.

A single specimen of this species is in Mr. Lea's collection, presented to him by Dr. Gould, and collected in the St. Johns River by the donor. It is a small shell about 1 inch in height and 1.3 inches in width; oval in outline, rather solid, and apparently adult, or nearly so, and quite inflated. The epidermis is shining and varies from yellowish chestnut at the posterior end to greenish brown, and is slightly rayed. The posterior end has a manifest ridge, and shows slight traces of biangulation; the nacre is bright purplish salmon, varying to brilliantly iridescent posteriorly. The shell is peculiar in being somewhat truncated or squarely built at the anterior end, and this

character is constant in all the specimens I have seen of this very variable species. I have before me six shells sent by Mr. B. H. Wright to the Museum (Museum No. 91133) from Lake Ashby, labeled by him *U. Fryanus*, that agree essentially with his figure and description of that species, which I am sure are only a variety of *coruscus*. They are larger than Lea's specimen, somewhat less inflated, and not quite so solid. Yet in general outline, color of epidermis, nacre, and teeth there is no essential difference, and they have the remarkable truncation of which I have spoken. Mr. Wright sent nine unios to the Museum (Museum No. 91135) from Lake Dias, which he labeled *Unio diasia*, five of which are no doubt *U. tetricus* and the remainder a form of *coruscus* with a dark epidermis. He also sent five shells, which he labeled *Unio Waltoni*, from Lake Ashby (Museum No. 91132), which are not that species, but a form of *coruscus* slightly drawn out at the posterior end and having a rough epidermis. Another shell is before me collected by Dr. Stimpson, and labeled by him "*Unio tetricus* Lea, Tampa Bay" (Museum No. 73182), which is very much like the last, but is rather narrower across the anterior end, and is no doubt the species under consideration. Specimens in Mrs. Andrews' collection, which Mr. Wright labeled "*Unio coruscus* Gld.," are almost exactly like those he has called *U. Waltoni*, to which I have referred.

I have no less than fifteen different lots of unios before me, sent under various names, collected in numerous localities from the St. Johns to Tampa, which I am satisfied are all forms of the present species, as I find no characters among them on which to base a separation.

Unio occultus Lea.

(Plate LXIII, Figs. 5, 6.)

Unio occultus Lea. Obs. IV, p. 37, Pl. XLI, Fig. 7, August 18, 1843. Black Creek and Lake Monroe; S. B. Buckley.

This species approaches very close to some specimens of *tetricus*, but is usually larger, not so wide, is not so much disposed to be biangulate behind, and is rather more lenticular than that shell. Some of the young are very close to young *fuscatus*, but are hardly so wide and, as far as I have seen, are darker and solider. It is hard to separate, when young, from half-grown specimens of *denigratus*, but the latter is in general more rhomboid in form. The epidermis is usually rather dark and feebly rayed, the nacre bronzy or coppery, and not very bright.

Unio fuscatus Lea.

(Plate LXIII, Figs. 2, 4.)

Unio fuscatus Lea. Obs. IV, p. 31, Pl. XL, Fig. 4, August 18, 1843. Black Creek; S. B. Buckley.

Much confusion exists concerning this species as well as the preceding and following. Certain forms of *tetricus* approach very close to the

young or nearly adult *fuscatus*, and are generally sent out under the latter name, and for years I have been perplexed as to the two. This seems to be a somewhat rare shell, while the former is very abundant It is a rather wide thin species, slightly biangulate posteriorly, generally light chestnut colored, slightly rayed, and having a pale chocolate non-iridescent nacre. Old specimens sometimes become produced at the posterior ventral region until the outline of the shell is arcuate.

Unio tortivus Lea.

(Plate LXIII, Fig. 8; Plate LXIV, Figs. 1, 3, 4.)

Unio tortivus Lea. Obs. III, p. 42, Pl. XII, Oct. 2, 1840. Chattahoochee River, Georgia; Dr. Boykin.

Unio tetricus Lea. (Plate LXIV, Fig. 2.) Obs. VII, p. 13, Pl. XXII, Fig. 78, June 23, 1857. Flint River, near Albany, Ga.; Bishop Elliott.

This small species is abundant in the Atlantic drainage of Georgia, extending into eastern Alabama, and throughout the greater part of the State of Florida. I found thousands of specimens in Horse Creek, Manatee County, of the latter State, in about latitude 27°. It is as variable a species as *U. Buckleyi;* specimens often being found in Georgia greatly compressed, extremely wide and arcuate; or it may be oblong, oval, and considerably inflated.* The wide flat forms are exceedingly close to *U. arctatus*, or even *U. Lazarus*, and it is doubtful whether they are really distinct; while the more rounded specimens approach *fuscatus* and *occultus.* The adult shells of this species so far as I have seen are invariably dark; the epidermis ranging from chestnut brown to black; sometimes feebly rayed when young; the nacre is chocolate or dark coppery, and usually dull.

The species is better known as *U. tetricus*, but *tortivus* is the older name, and an examination of hundreds of specimens from Lea's collection and elsewhere convinces me that there is no dividing line between them. As a rule, *tortivus* is more compressed in general form, and *tetricus* more inclined to posterior biangulation, but this does not always hold good. I have before me in one tray four specimens received from Mr. B. H. Wright (Museum No. 91134), collected in Lake Beresford, and labeled by him *U. coruscus*, which I have been much puzzled over. They are considerably inflated, wide, black, rather solid shells, with a single posterior ridge, slightly inclined to biangulation, and bluish chocolate nacre. In the lot sent to the Museum under the name of *U. diasia*, by Mr. Wright, from Lake Dias (Museum No. 91135), are five more, which are evidently the same. They seem to stand between *U. tortivus* and the form which Mr. Marsh has named *U. Ferrissii*, and are, I think, a variety of the former.

* Since the above was written the writer has received a very large and enormously swollen specimen of the above species, collected at Cowan Swamp, near St. Augustine, Fla., by Mr. Chas. W. Johnson, of the Wagner Institute, of Philadelphia, and of which two natural sized outlines are given.

Unio denigratus Lea.

(Plate LXV, Fig. 1.)

Unio denigratus, Lea. Obs. VII, p. 18, Pl. XXIII, Fig. 83, June 23, 1857. Streams near Columbus, Ga.; Bishop Elliott.

This species is close to *U. tortivus*, and the young can hardly be separated at times, but it seems to differ constantly in being more rhomboid when adult, approaching the form of *Margaritana calceola*. I have it before me from Lake Monroe and St. Augustine, collected by F. Rugel, and now in the collection of Mrs. Andrews.

Unio insulsus Lea.

(Plate LXV, Figs. 1, 5.)

Unio insulsus Lea. Obs. VIII, p. 57, Pl. I, Fig. 199. Roanoake R., N. C.; Prof. Emmons.

A small, inflated species, greenish brown, and obscurely rayed, and, as Dr. Lea remarks, very closely related to *U. confertus*. I am inclined to believe it but the young or a small form of the latter, as the differences seem to be that *U. confertus* is larger, and with age becomes black, and is in some examples not greatly inflated. Lea has a specimen of the species under consideration from Savannah. In Mrs. Andrews's collection there is a shell collected by Rugel, and labeled "Florida," which is evidently this.

Unio Cunninghami B. H. Wright.

(Plate LXV, Fig. 6.)

Unio Cunninghami B. H. Wright. Proc. Acad. Nat. Sci., Philadelphia, 1883, p. 58, Pl. I, Figs. 1, 2, 3, and 4. Sumter County, Fla.

This species is very commonly sent out as *Unio Buddianus* or *Buckleyi*, but is really one of the most distinct in Florida.

It is a solid, greatly inflated, triangular shell, wide at the anterior end, and rapidly tapering from just behind the beaks to the posterior ventral region; the dorsal line being curved, the ventral straight or even arcuate. The color varies from greenish or yellowish ash to chestnut black, generally shining, and *very rarely faintly rayed;* the teeth are strong and ragged; nacre brilliant, and varying from silvery to purple. One specimen before me labelled "Florida," and belonging to Mr. Marsh, is almost jet black, 1.25 inches in length and 1.80 inches wide, and is as ponderous as any adult *crassidens*. Young shells are sometimes very much like *Unio micans*, but are generally solider. So far as I know the species is confined to the lake region.

Unio micans Lea.

(Plate LXV, Fig. 3.)

Unio micans Lea. Obs. VIII, p. 63, Pl. III, Fig. 207. Catawba R., N. C., C. M. Wheatley and Dr. Genth.

It is also in Mr. Lea's collection, sent by Dr. Barrett from South Carolina. An elegant little species, something like a miniature *Buckleyi*, but wider. The epidermis in the dozen specimens before me varies from tawny yellow or greenish to fulvous brown. All are rayed, and the young are particularly bright colored. The nacre in the anterior of most of the shells is dull and sometimes lurid; that of the posterior is iridescent. One small shell and a larger right valve belonging to the Museum (Museum No. 25146), from the Kidder collection, labeled "*Unio trossulus* Lea, Sumter County, Florida;" though less wide than Lea's specimens, I refer to this species. It is very close to *U. perlucens*, *Lea.*

Unio Hinkleyi B. H. Wright.

(Plate LXV, Fig. 4.)

Unio Hinkleyi B. H. Wright. Proc. Acad. Nat. Sci, Phila., 1888, p. 117, Pl. IV, Fig. 2. Lake Monroe, Fla.

A puzzling and doubtful species. Three specimens before me from Lake Monroe, sent by Mr. B. H. Wright to the Museum (Museum No. 91127) as *U. Hinkleyi*, are probably what he has described as that species. Two agree very well with his figure and description except that the nacre is coppery; the third approaches the form he has called *Dalli*, and has a lurid, blotched nacre. I have examined several other shells, some of which approached *Buckleyi* and others *monroensis.*

I let the species stand because I can not refer it to any known form. It seems to reach out in several directions, and to connect more or less with *Buckleyi*, *monroensis*, and *Downiei*, and to strongly hint that a large number of so-called species of the southeastern waters are but variations of an unbroken chain.

Unio Ferrissii Marsh.

(Plate LXVI, Figs. 1, 2.)

Unio Ferrissii Marsh. Joliet Weekly News (a newspaper), May 1, 1891. The Nautilus, Vol. V, No. 3, p. 30.

Shell oblong, inflated, smooth before, slightly plicate posteriorly, rather thick and solid; epidermis dark green or black and shining, with capillary rays, sometimes rayless; squarish before, pointed behind; umbonial slope raised, obtusely rounded. Cardinal teeth compressed, thick and solid, oblique, single in the right valve, double in the left, striate. Lateral teeth short and slightly curved; anterior cicatrices not confluent, very deep, posterior cicatrices distinct; nacre pink and iridescent. A small creek near Palatka. The above is the original description. A puzzling form allied to *U. Buckleyi* on the one hand and the *crassidens* group on the other. The specimens I have seen have

quite a strong posterior ridge, and are subplicate on the posterior-dorsal slope. I can not connect it with any described species.

Unio obnubilus Lea.

(Plate LXVI, Fig. 3.)

Unio obnubilus Lea. Obs. VI. p. 84, Pl. XVII, Fig. 64, June 23, 1857. Buckhead Creek, Burke County, Ga.; Bishop Elliott.

Unio Nolani B. H. Wright. Proc. Acad. Nat. Sci., Phila., 1888, p. 116, Pl. IV, Fig. 1.

Lea's figure is that of a male which is not so produced in the posterior ventral region as the females. Mr. Wright's figure of *U. Nolani* is that of a female, and excellently represents dozens of female specimens of *U. obnubilus* before me, most of which have been labelled by Dr. Lea. Although he described his species as uniform in color, several specimens received by him later are rayed. Three are before me belonging to Mrs. Andrews, collected by F. Rugel in Black Creek, Florida, and labelled *Unio nolani* by Mr. S. H. Wright, which agree in every respect with Lea's types of *obnubilus*. Another shell from the same locality and collection, which is identical with this, Mr. Wright has labelled *U. Tuomeyi*. The color of the epidermis and nacre is much like *occultus*, but the form is more quadrate, and it is a larger species, yet the young are very like those of the latter.

Unio lugubris Lea.

(Plate LXVI, Fig. 4; Plate LXVII, Fig. 1.)

Unio lugubris Lea. Obs. II, p. 30, Pl. IX, Fig. 25, Feb. 25, 1836. Hopeton, near Darien, Ga.; Prof. Shepard.

A species allied to *ocumulgeensis*, *Geddingsianus*, *Whiteanus*, and to some forms of *U. Buckleyi*, and which does not possess any very decided characters. The young shells are often blackish green and rayed; the adults become brownish black; they lose their luster, and are sometimes arcuate when old. Lea's figure poorly represents the species. Several young shells from Black Creek, collected by Rugel and now in Mrs. Andrews's collection, are undoubtedly this species.

Unio ocmulgeensis Lea.

(Plate LXVII, Fig. 5.)

Unio ocmulgeensis Lea. Obs. VIII, p. 89, Pl. XIV, Fig. 243, Feb. 5, 1861. Little Ocmulgee R., Ga.; S. M. Wilson.

Lea's figure is from a badly eroded specimen, though the form is characteristic. Some of the young shells are green, or blackish green and chestnut, elegantly rayed and polished, and resemble *U. Buckleyi*, but many are a dull uniform blackish, and in outline are much like *U. Jayanus*. In most of the specimens the nacre is not brilliant save at the posterior end, where it is richly iridescent. One shell belonging to Mr. Marsh, and collected by Mr. Upson, of Rockford, Ill., is before me, and another, collected by Rugel, among Mrs. Andrews's shells, both labeled Florida, are undoubtedly this species.

GROUP OF UNIO PARVUS.

A group of small and usually well characterized shells, distributed throughout the entire Mississippi Basin, the Gulf drainage, and in that portion of the Atlantic Slope from South Florida to North Carolina. In form they are oval, or obovate to oblong, usually rounded before and behind, rather inflated, with generally dark and lusterless epidermis, though it is sometimes smooth, shining, and rayed. The beaks are undulate; the teeth usually compressed and often curved; the nacre is almost always brilliant, silvery, bluish, and iridescent, though a few of the species have dark and lurid interiors.

Unio minor Lea.*

(Plate LXVII, Fig 2.)

Unio minor Lea, Obs. IV, p. 34, pl. XXXIX, Fig. 3. Aug. 18, 1843, Lakes Monroe and George; S. B. Buckley.

An interesting species and one of the very smallest, an adult before me from Lake Monroe, one of Lea's types, being 0.9 inch in width and 0.6 inch in length, while others from the same locality, in Mrs. Andrews's collection, are 1.50 inches in width by 0.80 inch in length. The species is regularly obovate in form, inflated and wedge-shaped when viewed from the base; being of greatest diameter in the neighborhood of the beaks and tapering to the posterior end. The epidermis is rough and black; the nacre bluish and iridescent behind; the teeth are rather strong, as the substance of the shell is quite solid.

This shell is sometimes mistaken for *U. marginis*, but is darker colored, solider, more inflated, and rather wider. Dr. Lea did not know whether the beaks were undulate or not, and all the numerous specimens I have seen are so eroded I can not tell certainly, but it is probably like the rest of the group in this respect. Three shells before me, belonging to Mrs. Andrews, are from the Edisto River, South Carolina, and I found it in Horse Creek, Manatee County, in latitude 27°.

Unio vesicularis Lea.

(Plate LXVII, Fig. 4.)

Unio vesicularis Lea, Obs. XIII, p. 41, pl. XII, Fig. 34. Sept. 15, 1873, Okechobee; Dr. Budd and C. M. Wheatley.

Lea described this species from very poor material, two worn, badly eroded opposing valves and a smaller pair in poor condition. These vary from light to dark olive green and are slightly rayed. A worn specimen in Lea's collection from Lake George, labeled by him *Unio amygdalum*, scarcely differs from the opposing valves which are his type of *vesicularis*. It is a trifle less wide and not quite so inflated. I

* There are two Unios in the Museum collection (No. 91130) from Blue Springs Landing, Fla., received from Mr. B. H. Wright and labeled by him *Unio Stearnsiana* Wright, which are typical examples of *Unio minor* Lea.

found this species rather abundant in Horse Creek, Manatee County, and these specimens had a rough, dark epidermis, and were wedge-shaped when viewed from the base. Five shells from the St. Johns, donated to the Museum by Mr. B. H. Wright (Museum No. 91137) are much like those from Horse Creek, but show a dark-greenish ground with feeble rays when wetted or held up to the light. The species is larger, not quite so obovate, less inflated, and thinner than *U. minor*. A specimen in Mrs. Andrews's collection from F. Rugel, and labeled by him "Alabama," I regard as this species.

Unio amygdalum Lea.

(Plate LXVII, Fig. 3.)

Unio amygdalum Lea, Obs. IV, p. 33, pl. XXXIX, Fig. 1. Aug. 18, 1843, Lake George; S. B. Buckley.

It is quite probable that this species and the one preceding and the one following it are forms of the same thing, yet with the limited material I have I hardly feel justified in uniting them. Several of Lea's specimens of this are very thin, yellowish ash, quite strongly rayed, and are fringed at the posterior end by the frayed outgrowth of the epidermis. Another in his collection, from Lake George (Mus. No. 86128), is wider, darker, and solider; closely approaching *vesicularis*.

It inhabits from Dooly County, Ga., to central Florida.

Unio lepidus Gould.

(Plate LXVIII, Fig. 1; Plate LXIX, Fig. 3.)

Unio lepidus Gould, Proc. Bost. Soc. Nat. Hist., vol. VI, p. 15. Creek near Lake Monroe.

From Gould's description this is very close to the last two species, as he says it is nearly allied to *U. trossulus*, but is larger, more fragile, and the cardinal teeth are more compressed. (Otia Conchologica, p. 222.) The species is not in Lea's collection, but there are among the Museum shells three fine examples from the St. Johns, donated by Mr. B. H. Wright (Museum No. 91140), and by him labeled *lepidus*, which are, no doubt, that species. They are a little wider than *vesicularis* or most of the examples of *amygdalum* I have seen; are more oblique; are yellowish, shading to dark green on the posterior portion, and more or less rayed throughout. The nacre is shaded salmon and bluish, and is iridescent posteriorily. I have other examples before me which are evidently the same.

Unio Singleyanus Marsh.

(Plate LXVIII, Figs. 4, 5.)

Unio Singleyanus Marsh, Joliet Weekly News (a newspaper), May 1, 1891. The Nautilus, vol. V, No. 3, p. 29.

Shell smooth, oval, slightly depressed; inequilateral; valves rather thick, squarish before, rounded behind; beaks small and flat; epidermis

yellowish brown, shining, with or without rays; usually rayless. Cardinal teeth crenulate, oblique, single in the right valve, double in the left. Lateral teeth short and straight; anterior cicatrices small, deep, not confluent; posterior cicatrices confluent, slightly impressed; nacre white, iridescent. A small creek near Palatka. The above is the original description. This seems to be perfectly distinct from *U. marginis*, its nearest ally. Its smooth epidermis which, in all the specimens I have seen, is very light colored, even to yellowish, and the peculiar truncation of the anterior end, like *U. coruscus*, are its strongest characters. It is an undoubted member of the *parvus* group.

Unio papyraceus Gould.

(Plate LXVIII, Fig. 2.)

Unio papyraceus Gould, Proc. Bost. Soc. Nat. Hist., vol. II, p. 53· Aug. 20, 1845. Everglades.

There are in the Museum collection two trays containing seven specimens of this species given to Mr. Lea by Dr. Gould, labeled "Everglades, Cape Florida." Part of them have been stained a brownish tint by coloring matter in the water; the others are olive to ash, with greenish rays. They are as fragile as *Anodonta imbecillis*, and Gould compares them to *A. Couperiana*, but the form and external coloring, as well as the bluish nacre becoming richly iridescent posteriorly, are almost exactly like *U. amygdalum*, from which they seem to differ only in being more fragile.

Unio trossulus Lea.

(Plate LXVIII, Fig. 3.)

Unio trossulus Lea, Obs. IV, p. 36, pl. XL, Fig. 6. Aug. 18, 1843, Lake Monroe.

This species is quite different from *U. parvus*, the type of the group, but is related by *amygdalum* and *vesicularis* to *minor*, which is near to *parvus*. I have seen but one specimen of the present species, Lea's type, which is a somewhat peculiar shell, resembling in some respects the smaller, brighter forms of *amygdalum*, but it is *more oblique* and is quite small, being only 1.4 inches in width by 0.7 inch in length. It has the undulate beaks common to the group, as well as the silvery and iridescent nacre, but is *remarkably solid*, with rather strong, subcompressed, ragged cardinals and heavy roughened laterals.

GROUP OF UNIO CAMPTODON.

Wide, large, somewhat quadrate or rhomboid shells, of rather light structure; without well-defined posterior ridge; with epidermis varying from smooth, shining, and yellowish, to squamose, rough, and black. The nacre in the type is white, but it is often lurid or purplish in some of the species. The members of the group range from Virginia to South Florida, and west to Kansas and Texas.

Unio obesus Lea.

(Plate LXVIII, Fig. 6; Plate LXIX, Figs. 1, 2, 4; Plate LXXI, Fig. 3.)

Unio obesus Lea, Obs. I, p. 106, pl. XIII, Fig. 26. May 7, 1830. York River, Va.; Wm. Cooper.

Unio Blandingianus Lea (Plate LXX, Figs. 1, 2), Obs. I, p. 213, pl. XV. Fig. 44. Feb. 7, 1834.

Unio paludicolus Gould (Plate LXXI, Fig. 2), Proc. Bost. Soc. Nat. Hist., Aug. 15, 1845 Everglades.

Unio Jewettii Lea (Plate LXXI, Fig. 1), Obs. XII, p. 36, pl. XXXVII, Fig. 89, June 2, 1868, Sink of Noonans Lake; Col. Jewett.

Unio rivicolus Conrad., Am. Jour. Conch. IV, p. 280, 1868. Brook near Tampa, Fla.

Unio Websteri B. H. Wright (Plate LXX, Fig. 3), Proc. Acad. Nat. Sci. Phila, 1888, p. 113, pl. II, Fig. 2. Lake Woodruff, Volusia County.

This species, though varying less than many others, has unfortunately received a great number of names. The form is that described with the group; in the type it is somewhat inflated and rounded ventrally; the epidermis is never smooth, varying from ashy and greenish olive to jet black; the scaly or laminated covering of the very dark examples is often glossy. In Lea's collection of *obesus* some of the specimens have a reddish epidermis, and it is this variety, I think, that Mr. Wright has described as *U. Websteri*. A shell collected in Lake Woodruff, so labeled by him, and donated to the Museum (Museum No. 91128), is undoubtedly *U. obesus*. *U. rivicolus* Con., judging by his figures and description, is identical with the form Lea described as *U. Blandingianus;* the variety with rough, glossy epidermis, often becoming somewhat arcuate with age. *U. Jewettii*, though sometimes shaded with green and partially rayed, connects these forms with the type. *U. paludicolus*, judging from Gould's description and shells that he sent Lea from the typical lot, appears to be the young or perhaps a dwarf form of the species under consideration. Such a form, somewhat widened posteriorly, was found abundantly by the writer in Manatee County, and I have the same before me from several localities. Some of these from Spring Creek, belonging to Mrs. Andrews, have reddish chestnut epidermis and salmon coppery nacre, yet they are, no doubt, a variety of the above.* It is very doubtful whether *U. declivis* and *columbensis* are anything more than forms of this species. Both generally have a couple of shallow furrows running from near the beaks down the dorsal slope, but this feature is sometimes seen in the varieties I have noticed. The former is occasionally nearly smooth, suggesting *U. camptodon* and *manubius*. The latter is generally a wider shell than the type. It may be said that the *obesus* form is found along the Atlantic slope, from

*I have recently received from Mr. Charles W. Johnson four specimens of what are undoubtedly *Unio obesus*, two of them from Pemberton's Ferry, on the Withlacoochee River, Florida, the others from a tributary of the St. Johns, the largest of which measures 1½ inches in width by seven-eighths inch in length; yet they are all quite solid shells and evidently adults. They are almost perfect representatives in miniature of some of Lea's very largest specimens of the species. I give a figure of one of them.

Virginia to Florida, *Blandingianus* and *Jewettii* in Florida, *columbensis* in the Georgia streams that drain into the Gulf, and *declivis* from the latter State west to Texas, though these limits do not always hold good.

I found thousands of the *Blandingianus* form in a little drain in the piney woods near Braidentown, which was always dry except during the rainy season, and its banks of slightly damp sand were full of dormant specimens. A number of these survived after lying out in the sun for months.

Unio squalidus Lea.

(Plate LXXI, Fig. 4.)

Unio squalidus Lea, Obs. XII, p. 26, pl. VII, Fig. 20, June 16, 1863, Neuse River, Raleigh, etc.; E. Emmons.

Lea's description of this shell seems somewhat contradictory, as he says it is smooth, and in his remarks that "it has that rough squamose epidermis which is generally found in the (*obesus*) group." His specimens, though rough, are somewhat glossy. It is a stunted-looking species, less wide than most of the *obesus*, and rather rhomboid in outline. In Mrs. Andrews' collection, shells labeled "Florida," by Rugel, are, I think, of this species. One of Lea's shells is faintly rayed.

GROUP OF UNIO ROTUNDATUS.

A small assemblage of more or less orbicular shells, which are often inflated and sometimes triangular. *Unio Beadleianus* on the one hand is nearly globose, while *U. lenticularis* is considerably compressed. Most of the species have a slight posterior ridge, though it is not constant; the epidermis varies from brown to chestnut; the hinge line is curved; cardinals somewhat ragged and compressed, and the nacre ranges from a silvery white to purple. The species are confined, for the most part, to the streams emptying into the Gulf, being found from the Suwanee to the Brazos, and to the Tellico River, Tennessee.

Unio succissus Lea.

(Plate LXXI, Fig. 5.)

Unio succissus Lea, Obs. V, p. 31, pl. XXI, Fig. 32, Mar. 5, 1852. W. Florida; Maj. Le Conte.

Unio cacao Lea (Plate LXXI, Fig. 6), Obs. VIII, p. 26, pl. LVI, Fig. 169, Mar. 10, 1859, Chocktahatchie R., Fla.; Maj. Le Conte.

Lea has singularly confused this and allied species. He described it from a single specimen, a somewhat obovate, compressed shell, with an ill-defined posterior ridge, a chestnut epidermis and chocolate purple iridescent nacre. It is rather solid in structure, and has quite a heavy hinge plate, with strong irregular cardinals and nearly straight laterals, slightly curved posteriorly. Subsequently he received another specimen from New Orleans, presented by Mr. Wheatley, which

is more inflated, has compressed cardinals, and a narrow hinge plate, a shell I should refer to *chickasawhensis*. Another, a right valve, was entered with this species in the Museum collection (Museum No. 84574), and credited to West Florida; Maj. Le Conte, in the record book; but Lea does not mention this valve in his description, and states that but a single specimen was sent by Le Conte.

Sometime ago, in working over the Lea duplicates, I found a left valve that recalled *succissus*, and, on comparing, saw that it belonged with the one said to come from west Florida. Dr. Lea had labeled it and the shells with it "*Unio rubiginosus* Lea, *cerinus* Con., Alexandria, La., Dr. Hale." It is not *rubiginosus* or *succissus*, in my opinion, but agrees pretty well with the description and figure of Conrad's species, which is probably a valid one. *Unio cacao*, described from a single shell from west Florida seven years later, is merely a younger specimen of *succissus*, and agrees with the type of that species in every respect. Lea has placed the latter in his collection with *chickasawhensis*, *rotundatus*, and *lenticularis*, and the former with *amabilis*, *tellicoensis*, and *glandaceus*, more than a thousand numbers distant.

GROUP OF UNIO ANODONTOIDES.

A striking assemblage of species typified in America by a common Mississippi Valley form, with a very wide and extra limital distribution, but which is quite constant in its characters throughout its entire range. The well-known *U. pictorum* and several European and west Asiatic species probably group with it.

Unio anodontoides Lea.

(Plate LXXI, Fig. 7; Plate LXXII, Figs. 1, 2, 4.)

Unio anodontoides Lea, Obs. I, p. 91, Pl. VIII, Fig. 11, May 7, 1830.
Unio floridensis Lea (Plate LXXII, Fig. 3), Obs. V, p. 30, Pl. XXI, Fig. 31, Mar. 5, 1852.
Chăcktáhatchi River, west Florida; Maj. Le Conte

This species is so well known that it is scarcely necessary to comment on it. It is abundant throughout the Mississippi area, and over most, if not all, that part of the United States which is drained into the Gulf, as such localities as "Colorado River, Texas;" "Withlacoochee River, Florida;" "Marietta, Ohio;" and Lodge Pole Creek, Colorado, where it was collected by the writer, will show. In the Ohio River, Texas, and some of the other Southern States it attains large dimensions; in south Georgia and Florida it becomes more fragile, is of moderate size, and is often *more rounded on the posterior margin*, and this form is evidently what Dr. Lea has described as *U. floridensis*. Specimens collected by Mr. C. W. Johnson from the Withlacoochee River, now in the Museum (Museum No. 104037) agree exactly in outline with the figure and description of that shell in the fifth volume of the Observations. Lea speaks of this species as having remarkably small teeth, a character always found in *anodontoides*, and of its resemblance to the latter

in color and peculiar texture. The single specimen from which he described the species was badly eroded and in poor condition, and is not in his collection, nor do I know where it is. I have specimens of *U. anodontoides* before me from various localities in southern Mississippi, Alabama, and Georgia, and the Withlacoochee River in Florida, collected by Johnson and Rugel, and by the latter from Simpson Creek, Florida.

GROUP OF UNIO NASUTUS.

Wide shells, of rather light structure; undulate beaks, and usually dark greenish, somewhat rayed, epidermis, with lurid purple, silvery, or bluish, often iridescent nacre. The posterior end is usually drawn out to a point; is sometimes more or less ridged and biangulate. *U. nasutus*, the type, is abundant on the Atlantic slope from Canada to southern Virginia, and is also found west to Illinois.

Unio aheneus Lea.

(Plate LXXIII, Fig. 6.)

Unio aheneus Lea, Obs. IV, p. 38, Pl. XLI, Fig. 9, Aug. 18, 1843. Black Cr., Fla.; S. B. Buckley.

Lea's type is a young specimen not over half grown. The epidermis is green and yellow, neatly rayed; the shell is compressed, very wide, rather narrow posteriorly, and somewhat widened behind, either biangulate or, in some specimens, ending in a single produced point. The nacre is usually lurid and coppery shaded, but specimens belonging to Rev. A. Dean, of Muncy, Pa., from Lake Ashby, are blackish almost without rays, and have dark purple nacre.

Unio Waltoni B. H. Wright.

(Plate LXXIII, Fig. 7.)

Unio Waltoni B. H. Wright, Proc. Acad. Nat. Sci. Phila., 1888, p. 144, Pl. II, Fig. 3. Lake Woodruff, Volusia Co.

This species is close to the last, as it is to several other members of the group. It is, however, a wider, larger species than *U. aheneus;* is more produced in the ventral region; has a rougher, darker epidermis; is slightly less solid, and has commonly a rather sharp point just in front of the beaks. It is probable that it may be found to connect with *aheneus*.

GROUP OF UNIO GIBBOSUS.

Wide, solid shells, with usually rough epidermis, varying from yellowish and green—in some species rayed or tesselated—to dark brown. Hinge plate heavy; teeth strong, the laterals well elevated and ending abruptly behind. Nacre varying from white, through salmon, to deep purple, variable in color often in the same species. There are in almost all the examples of the group one or more shallow furrows or depressions within, running from near the cardinals in a direction more or less

parallel with the dorsal line toward the posterior ventral region. Several of the species are strongly humped, especially in old specimens, and by the thickening of the substance of the shell and its growth at the ventral posterior point, become very ponderous and somewhat triangular in outline.

Unio subgibbosus Lea.

(Plate LXXIII, Fig. 5.)

Unio subgibbosus Lea. Obs. VI, p. 53, Pl. VI, Fig. 36, June 23, 1857. Oostanaula and Etowah rivers, Ga. Rev. G. White.

A single undoubted specimen, a female of this species, is before me, belonging to Mrs. George Andrews, collected by Rugel in Lake Monroe. The species is close to *gibbosus* on the one hand and *luridus* on the other. It is less wide and smaller than the former and not so pointed posteriorly, and more inflated than the latter. I think it probable that it is only a small southern race of *gibbosus*, as the latter has a wide distribution and has been found at Columbus, Miss., Claiborne, Ala., and other points in the Gulf drainage.

Unio subluridus, n. s.

(Plate LXXIII, Figs. 3, 4.)

Shell small, elliptical, somewhat narrow and rounded before, with a slight tendency to biangulation behind; valves somewhat thin, slightly inflated; epidermis striated, rather roughened and shining, yellowish chestnut, lighter at the beaks, without rays; cardinal teeth not large, subcompressed, double in the left valve, single in the right; laterals slightly curved, roughened, not heavy or greatly elevated; anterior cicatrices well impressed; nacre coppery and slightly iridescent. Diameter .55, length .85, breadth 1.50 inches. Locality, Orange Springs, Volusia County. C. W. Johnson.

Three shells of this little form are before me, and while they do not possess any very striking characters, yet I find it absolutely impossible to refer them to any described species, and, in fact, I hardly know in what group to place them. I had considered this a rather thin form of *U. luridus*, but it differs from that species in having much less solid teeth and more elevated cardinals, in the color of the epidermis and nacre, and in being a less solid shell. It bears some resemblance to forms of *U. tetricus*, but is not so wide, and is a much more evenly elliptical shell. There are traces of the furrows in the nacre which I have mentioned in connection with this group, and these with the rather heavy isolated laterals, as well as a slight resemblance to *U. luridus* (Plate LXXIII, Figs. 1, 2), incline me to place it here.*

* Since writing the above further study induces me to believe that this species groups with *Unio camptodon*.

GENUS ANODONTA.

GROUP OF ANODONTA IMBECILLIS.

Very thin, inflated, smooth, shining anodons, with undulate beaks, and having the epidermis brightly painted with shades of yellowish and green. The ventral region is well developed, the posterior end is rather pointed, the umbonal area is in most cases peculiarly flattened, and over it the delicate radiating lines of color are often beautifully undulated. The group is widely distributed, the type species being found from Rideau Canal, Canada, to Darien, Ga., and from Minnesota to Matamoras, Mexico.* The distinctions between the North American forms of anodons are very poor and ill defined. The northern specimens of *A. imbecillis* are wider and morecompressed at the beaks; in the south they are more inflated, of greater proportional length, with the umbonal region less depressed, until they seem to almost shade into *A. Henryana*, *A. Dunlapiana*, and *A. Couperiana*.

Anodonta Couperiana Lea.

(Plate LXXIV, Fig. 1.)

Anodonta Couperiana Lea. Obs. III, p. 65, Pl. XX, Fig. 46, Oct. 2, 1840. Hopeton, near Darien, Ga., J. H. Couper.

Anodonta Dunlapiana Lea. (Plate LXXIV, Figs. 2, 3.) Obs. III, p. 86, Pl. XXVII, Fig. 65, Oct. 21, 1842. S. Carolina; Mrs. Dunlap.

Dr. Lea claims that *A. Dunlapiana* is less oblique and more cylindrical than *A. Couperiana*, but his series of the former shows a gradual variation from one to the other. I doubt if *A. Henryana* from Mexico is more than a mere variety. In the younger shells the beaks are much compressed; in old specimens they become somewhat inflated.

EXPLANATION OF PLATES.

NOTE.—The figures are all the natural size of the specimens.

PLATE XLIX.

FIG. 1. *Unio infucatus* Cour. (U. S. Nat. Mus. register No. 84037); Georgia; light brown; p. 409.
2. The same (84034); Georgia; nearly smooth, black; p. 409.
3. *Unio Forbesianus* Lea; Georgia; type (84542); p. 410.
4. *Unio vestitus* Lea; Georgia; type (85333); p. 410.
5. *Unio infucatus* Cour. (84034); Georgia; smooth, black, inflated; p. 409.
6. *Unio Kleinianus* Lea (84081); Florida; brown; p. 409.

PLATE L.

FIG. 1. *Unio vestitus* Lea (85333); Georgia; p. 410.
2. *Unio Forbesianus* Lea (84542); Georgia; p. 410.
3. The same; Lake Monroe, Florida; p. 410.
4. *Unio moussonianus* Lea; type (85168); Georgia; p. 410.

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* *A. cygnea* Lam., of Europe, is no doubt a member of this group.

PLATE LI.

FIG. 1. *Unio monroensis* Lea; type (85169); Florida; p. 410.
2. *Unio pusillus* Lea; type (85241); Georgia; p. 411.
3. *Unio buxeus* Lea; type (85153); Abbeville, S. C.; p. 411.
4. *Unio Anthonyi* Lea; type (84986); Florida; p. 411.
5. The same; young (84985); Edisto River, South Carolina; p. 411.
6. *Unio pusillus* Lea; young (85241); Oguchee River; p. 411.
7. *Unio dorsatus* Lea (84494); Catawba River, North Carolina; p. 411.

PLATE LII.

FIG. 1. *Unio dorsatus* Lea (84496); Abbeville, S. C.; p. 411.
2. The same; Florida; p. 411.
3. *Unio hopetonensis* Lea (85390); Darien, Ga.; p. 412.

PLATE LIII.

FIG. 1. *Unio hopetonensis* Lea (85392); Georgia; p. 412.
2. *Unio dariensis* Lea (85690); Georgia; p. 413.

PLATE LIV.

FIG. 1. *Unio dariensis* Lea (85690), Georgia; compressed form, slightly folded; p. 413.

PLATE LV.

FIG. 1. *Unio Downiei* Lea (84854); Georgia; p. 413.
2. The same; Buck Lake, Georgia; solid eroded specimen; p. 413.
3. The same; Florida; p. 413.

PLATE LVI.

FIG. 1. *Unio exiguus* Lea (84974); Georgia; p. 414.
2. *Unio modioliformis* Lea (85029); South Carolina; p. 414.
3. The same; South Carolina; p. 414.
4. *Unio nigrinus* Lea; type (86132); western Florida; p. 414.
5. *Unio Downiei* Lea (84854); Florida; p. 413.
6. *Unio modioliformis* Lea (85029); male; South Carolina; p. 414.

PLATE LVII.

FIG. 1. *Unio subellipsis* Lea (85095); Georgia; p. 414.
2. *Unio rutilans* Lea (85090); Georgia; like fig. 3, pl. LVI, p. 414.
3. The same; Mississippi; like *nigrinus* and *Averillii;* p. 414.
4. The same; Georgia; male; somewhat solid, like *subellipsis;* p. 414.
5. The same; Georgia; p. 414.
6. *Unio Averillii* Wright (91142); Lake Ashby; Florida; p. 414.

PLATE LVIII.

FIG. 1. *Unio subangulatus* Lea; Florida; p. 415.
2. *Unio concestator* Lea (85102); Georgia; female; p. 416.
3. The same; Florida; female; p. 416.
4. The same; Columbus, Ga.; male; p. 416.
5. *Unio tenerus* Lea (85030); South Carolina; male; grows larger; p. 416.
6. *Unio Buckleyi* Lea (85234); Lake Monroe; Florida; p. 417.
7. The same; Enterprise, Fla.; p. 417.
8. *Unio tenerus* Rav. (85032); Georgia; female; p. 416.

PLATE LIX.

FIG. 1. *Unio Buckleyi* Lea (85235); Florida; like *Dalliana;* p. 417.
2. The same; Black Creek, Florida; very large and highly colored; p. 417.
3. *Unio Simpsoni* B. H. Wright. Author's collection, p. 417.

PLATE LX.

FIG. 1. *Unio Simpsoni* Wright; p. 417.
2. *Unio Buckleyi* Lea (85237); Florida; young *Buddianus;* p. 417.
3. *Unio Buddianus* Lea (85606); Florida; very large and old; p. 417.
4. The same; type (85607); St. Johns River; p. 417.

PLATE LXI.

FIG. 1. *Unio Orcuttii* S. H. Wright; Florida; p. 417.
2. *Unio Dalli* B. H. Wright (91126); Florida; p. 417.
3. *Unio Dorei* B. H. Wright; Black Creek, Florida; p. 417.
4. *Unio Jayanus* Lea (86031); Florida; p. 419.

PLATE LXII.

FIG. 1. *Unio Tryoni* B. H. Wright (91129); Florida; p. 419.
2. *Unio Marshi* B. H. Wright; Florida; p. 419.
3. *Unio leonensis* B. H. Wright; (91141); Florida; male; p. 419.
4. The same; Florida; p. 419.

PLATE LXIII.

FIG. 1. *Unio coruscus* Gould, (85239); Florida; p. 419.
2. *Unio fuscatus* Lea (85244); Florida; old specimens; p. 420.
3. *Unio Fryanus* B. H. Wright; Florida; p. 419.
4. *Unio fuscatus* Lea (85245); Florida; p. 420.
5. *Unio occultus* Lea (85249); Florida; male; p. 420.
6. The same; type (85247); Florida; p. 420.
7. *Unio coruscus* Gould.; Florida; p. 419.
8. *Unio tortivus* Lea (85674); Georgia; p. 421.

PLATE LXIV.

FIG. 1. *Unio tortivus* Lea; Georgia; extremely close to fig. 4, pl. LXIII; p. 421.
2. *Unio tetricus* Lea (85655); Georgia; p. 421.
3. *Unio tortivus* Lea; Florida; remarkably inflated; p. 421.
4. The same; dorsal view; p. 421.

PLATE LXV.

FIG. 1. *Unio denigratus* Lea; type (85568); Georgia; p. 422.
2. *Unio insulsus* Lea (85644); North Carolina; p. 422.
3. *Unio micans* Lea (85077); North Carolina; p. 423.
4. *Unio Hinkleyi* B. H. Wright (91127); Florida; p. 423.
5. *Unio confertus* Lea (85633); South Carolina; young; p. 422.
6. *Unio Cunninghami* B. H. Wright; Florida; p. 422.

PLATE LXVI.

FIG. 1. *Unio Ferrissii* Marsh; type; Florida; p. 423.
2. The same; dorsal view of type; p. 423.
3. *Unio obnubilus* Lea (85646); Georgia; female; p. 424.
4. *Unio lugubris* Lea; type (85638); Georgia; p. 424.

PLATE LXVII.

FIG. 1. *Unio lugubris* Lea (85631); old specimen; p. 424.
2. *Unio minor* Lea; type (85310); Florida; female; p. 425.
3. *Unio amygdalum* Lea; typical (86128); Florida; p. 426.
4. *Unio vesicularis* Lea; type (85292); Florida; p. 425.
5. *Unio ocmulgeensis* Lea; type (85901); Georgia; p. 424.

PLATE LXVIII.

FIG. 1. *Unio lepidus* Gould (91140); Florida; female; p. 426.
2. *Unio papyraceus* Gould; typical (86125); Florida; p. 427.
3. *Unio trossulus* Lea; type (84705); Florida; p. 427.
4. *Unio Singleyanus* Marsh; type, Florida; p. 426.
5. The same; dorsal view; p. 426.
6. *Unio obesus* Lea (85370); South Carolina; p. 428.

PLATE LXIX.

FIG. 1. *Unio obesus* Lea (85368); Georgia; p. 428.
2. The same; (85366); Georgia; p. 428.
3. *Unio lepidus* Gould (91140); Florida; male; p. 426.
4. *Unio obesus* Lea (85366); Georgia; p. 428.

PLATE LXX.

FIG. 1. *Unio Blandingianus* Lea (85714); Florida; p. 428.
2. The same; Sarasota, Fla.; depauperate; p. 428.
3. *Unio Websteri*, B. H. Wright (91128); Florida; p. 428.

PLATE LXXI.

FIG. 1. *Unio Jewettii* Lea; type (85374); Florida; p. 428.
2. *Unio paludicolus* Gould; typical (85713); Florida; p. 428.
3. *Unio obesus* Lea; Florida; adult; p. 428.
4. *Unio squalidus* Lea; type (85375); North Carolina; p. 429.
5. *Unio succissus* Lea; type (84574); Florida; p. 429.
6. *Unio cacao* Lea; type (85724); Florida; p. 429.
7. *Unio anodontoides* Lea (40718); Georgia; male; p. 430.

PLATE LXXII.

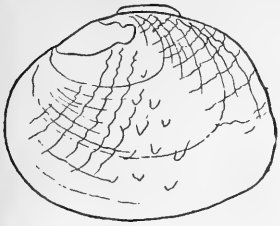
FIG. 1. *Unio anodontoides* Lea (104037); Florida; p. 430.
2. The same; female; p. 430.
3. *Unio floridensis* Lea; female drawn from Lea's type figure; p. 430.
4. *Unio anodontoides* Lea (25925); Georgia; female; p. 430.

PLATE LXXIII.

FIG. 1. *Unio luridus* Lea (85253); Georgia; p. 432.
2. The same; type; Georgia; female; p. 432.
3. *Unio subluridus* n. s. (104002); Florida; female; p. 432.
4. The same; type; dorsal view; p. 432.
5. *Unio subgibbosus* Lea (86099); Alabama; female; p. 432.
6. *Unio aheneus* Lea; type (86030); Florida; p. 431.
7. *Unio Waltoni* B. H. Wright (91145); Florida; p. 431.

PLATE LXXIV.

FIG. 1. *Anodonta Couperiana* Lea (86671); Florida; p. 433.
2. *Anodonta Dunlapiana* Lea; type (86564); South Carolina; female; p. 433.
3. The same; South Carolina; male; p. 433.



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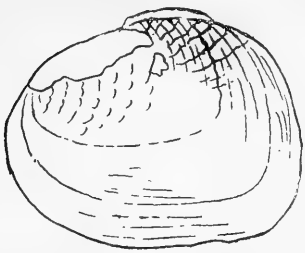

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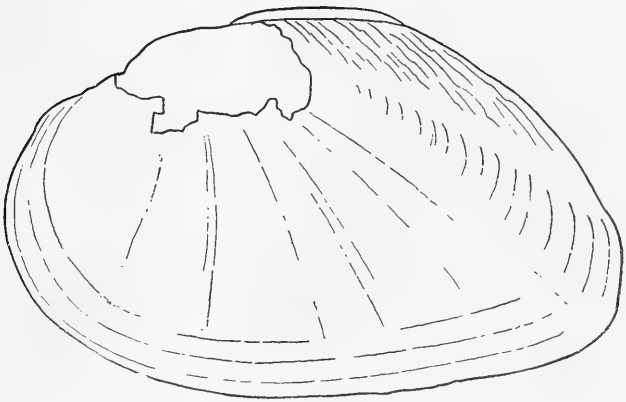

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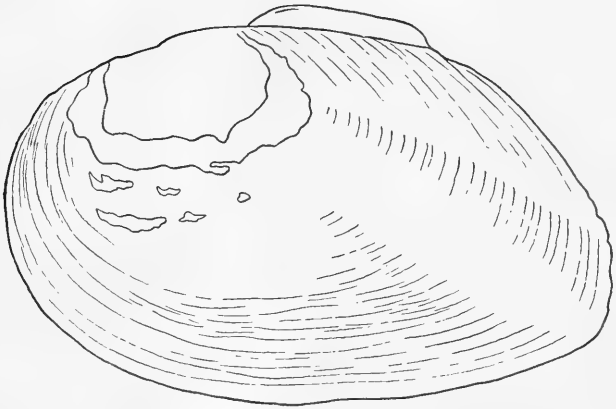

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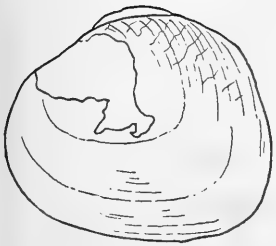

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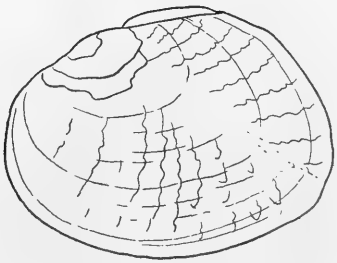

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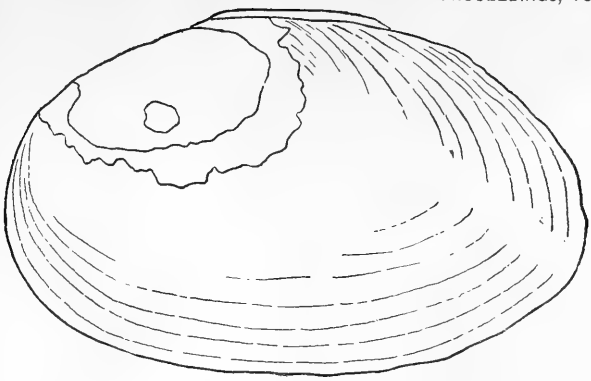
FLORIDA UNIOS.



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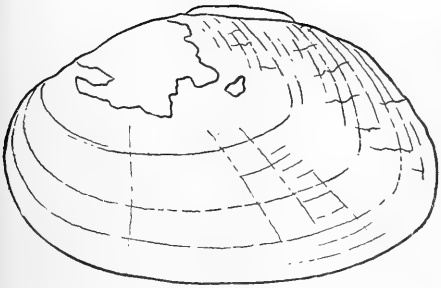

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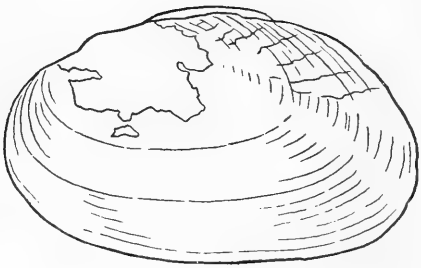

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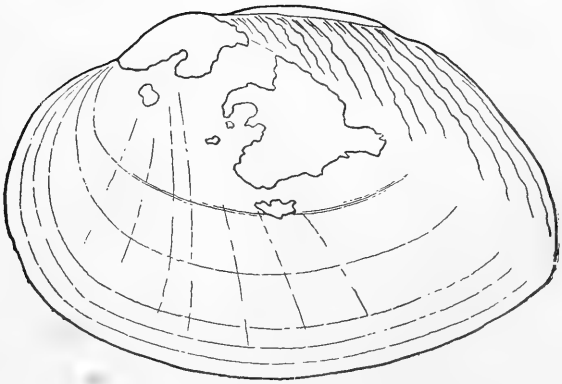

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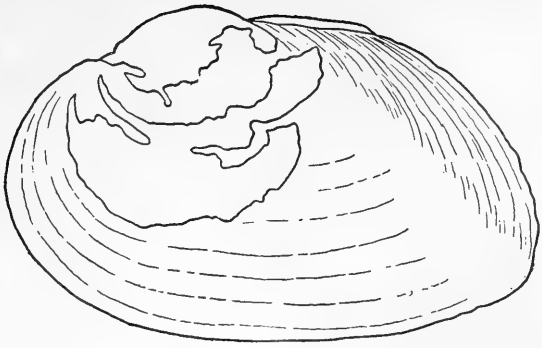

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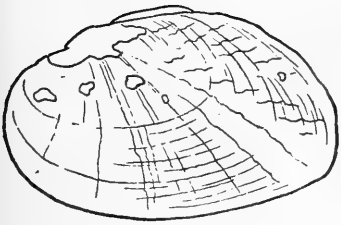

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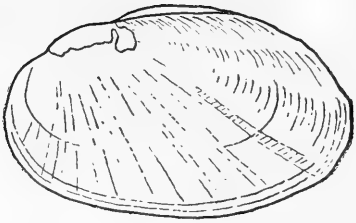

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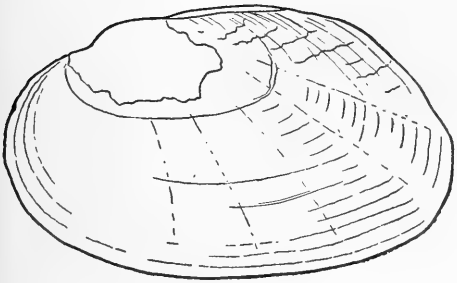

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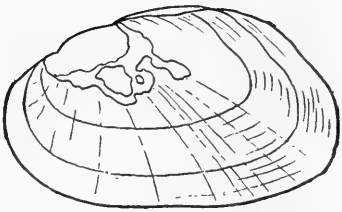

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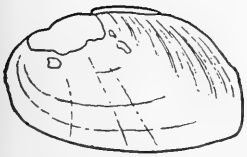

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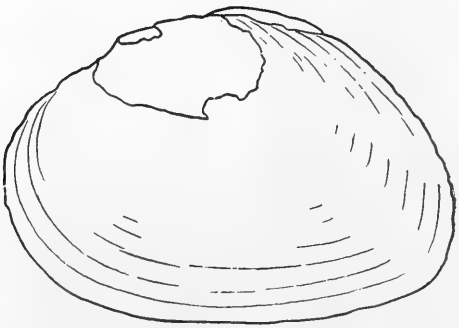

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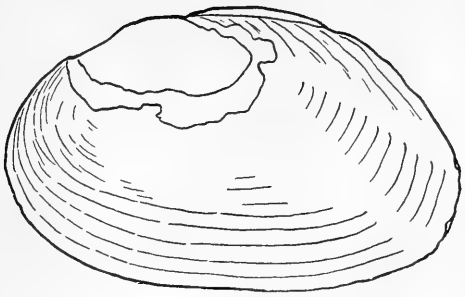

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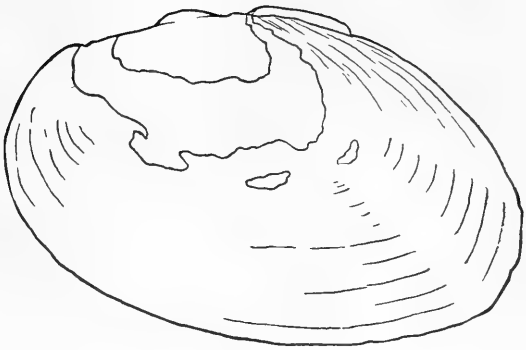

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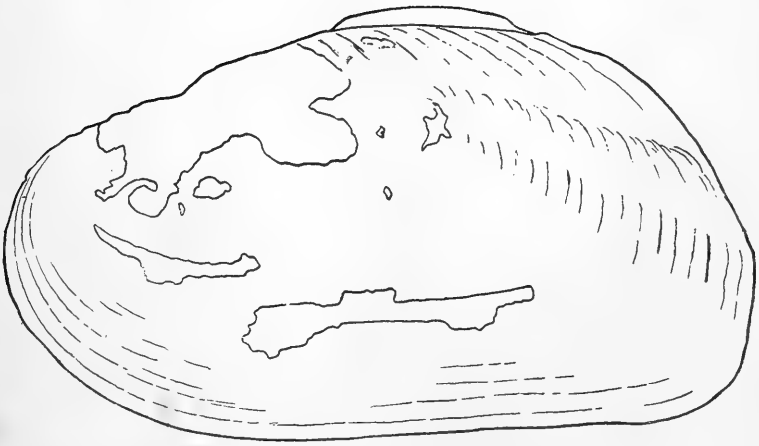

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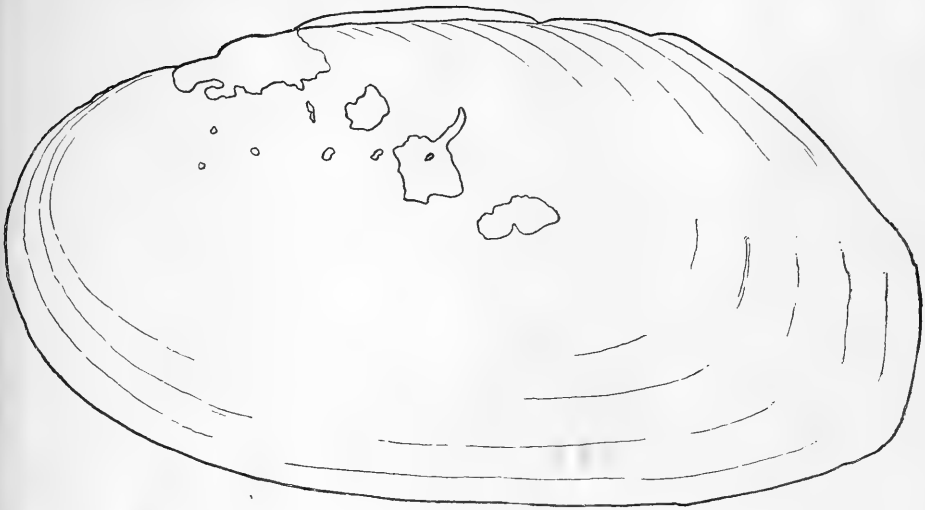

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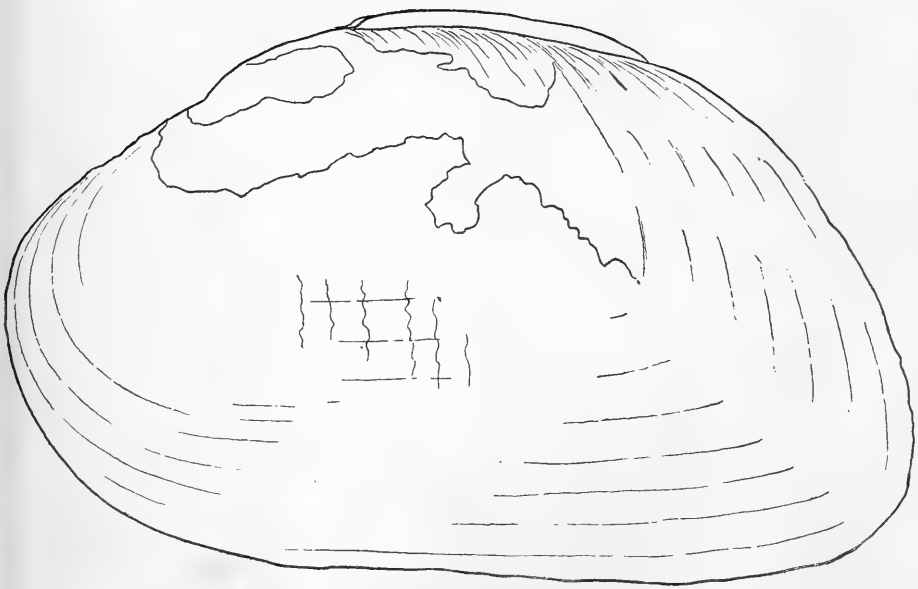

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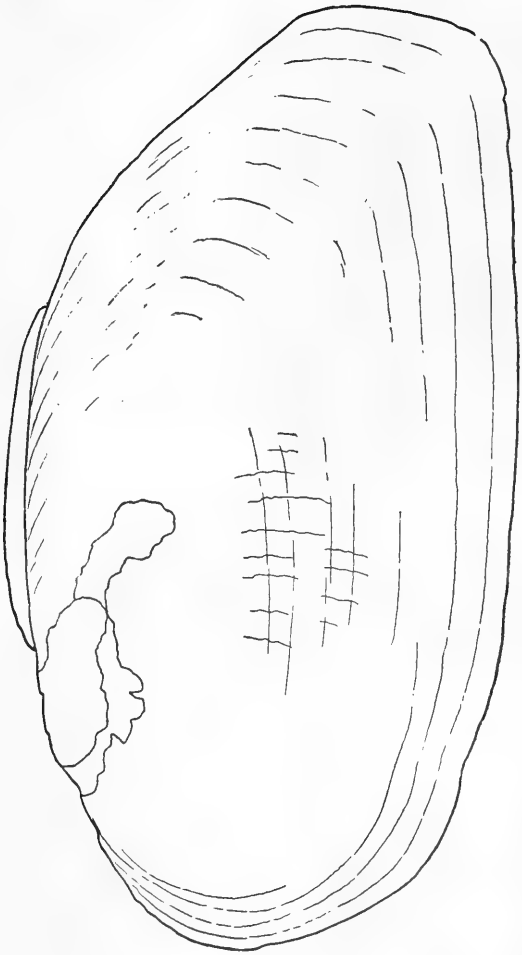

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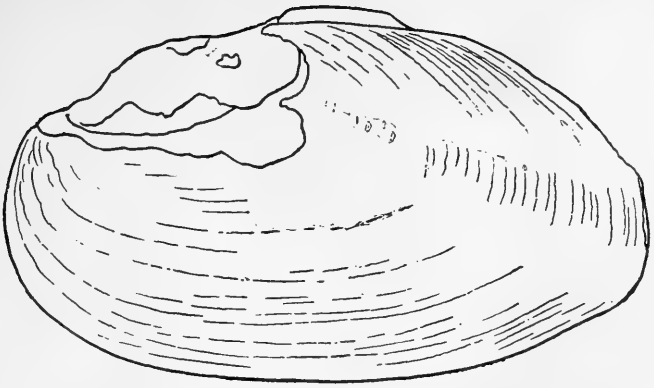

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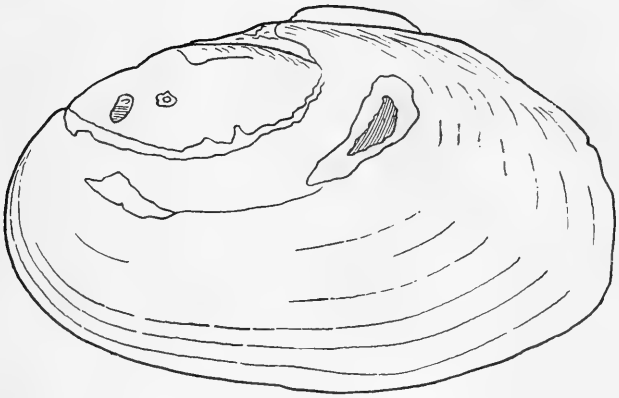

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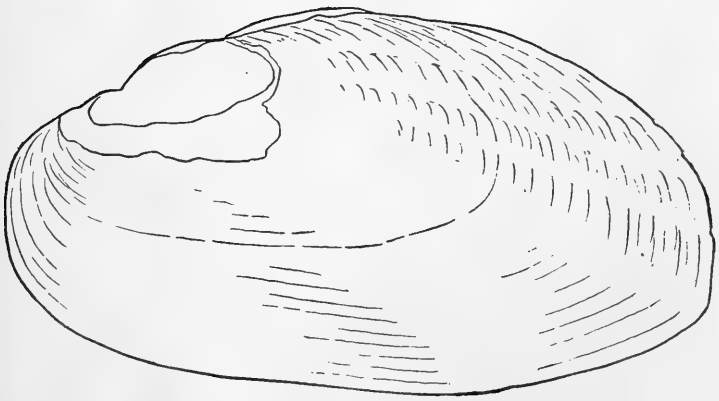

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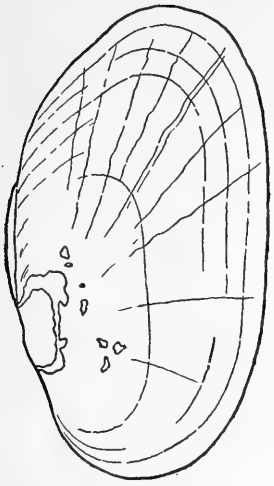

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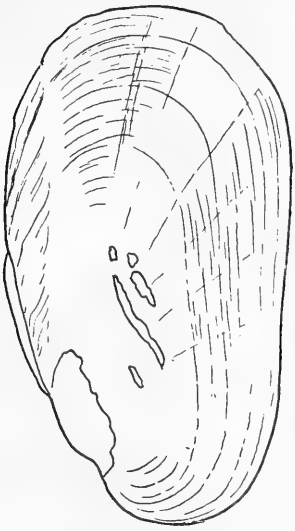

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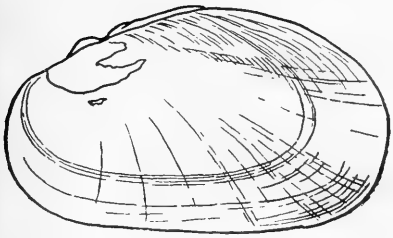

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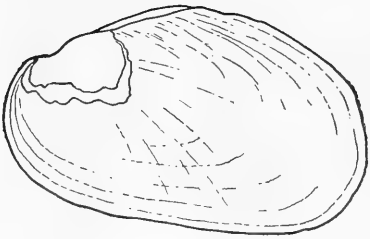

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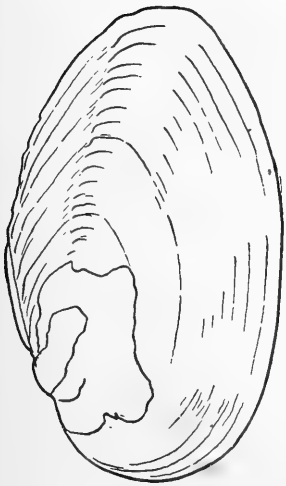

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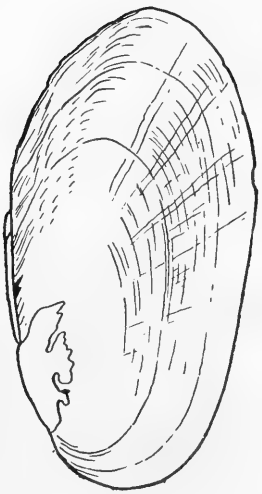

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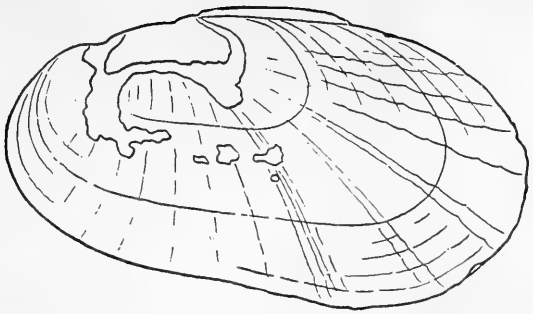

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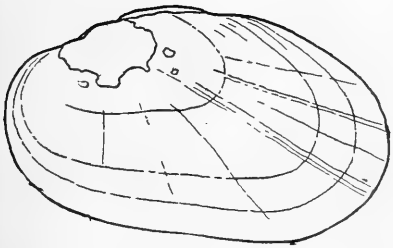

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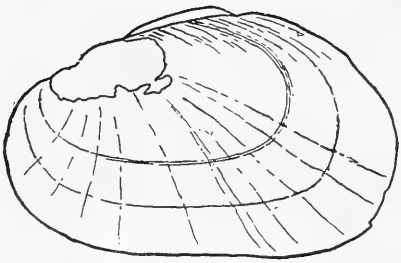

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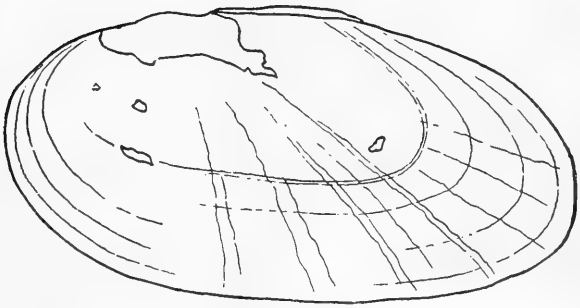

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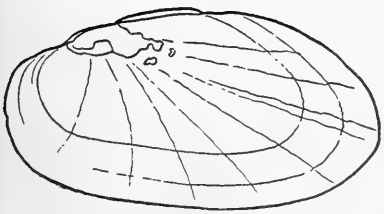

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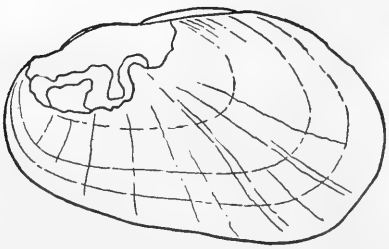

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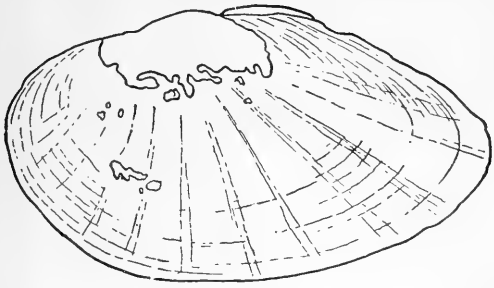

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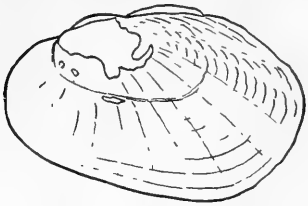

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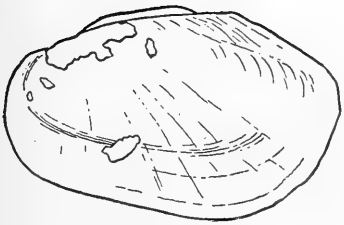

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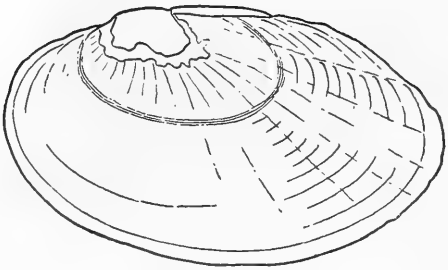

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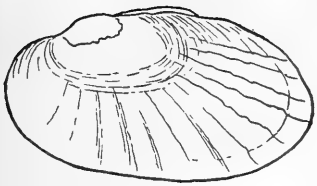

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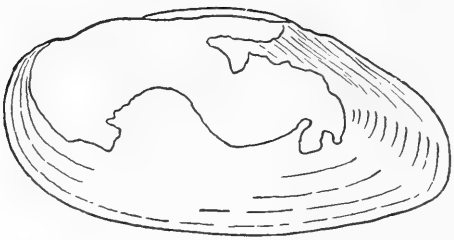

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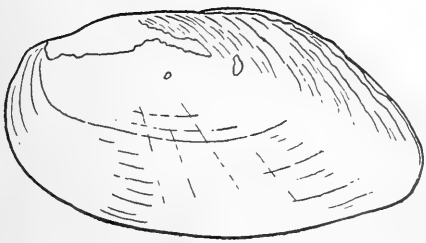

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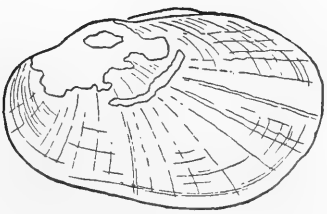

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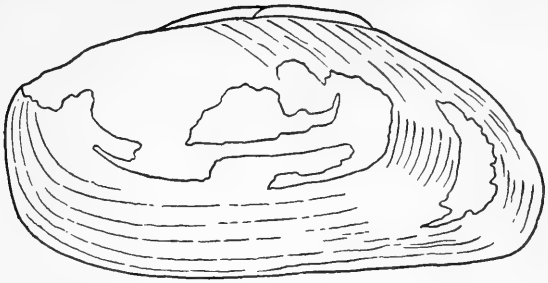

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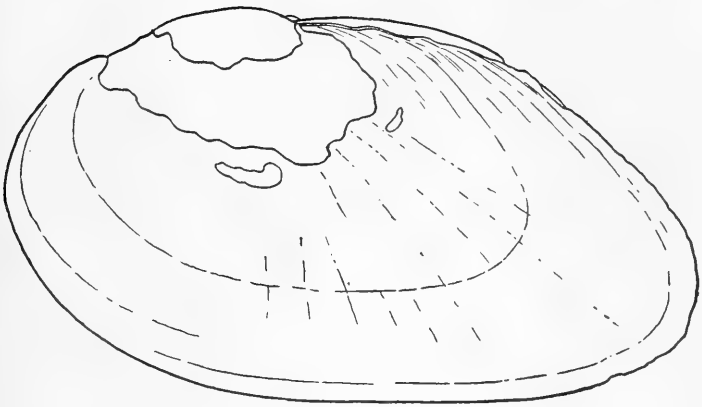

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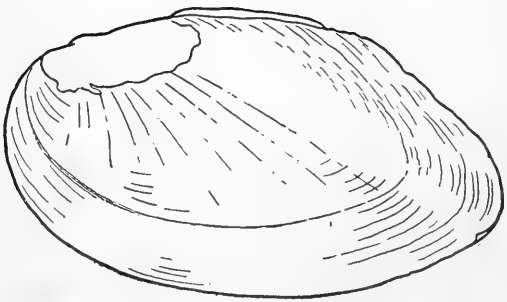

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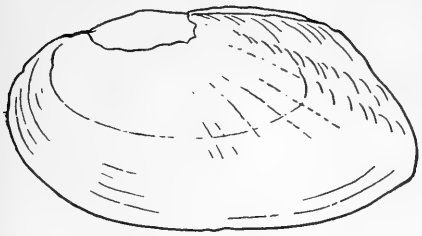

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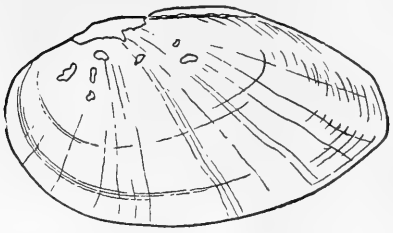

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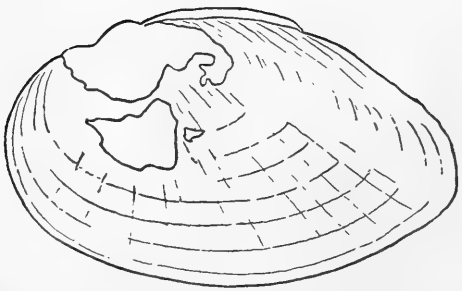

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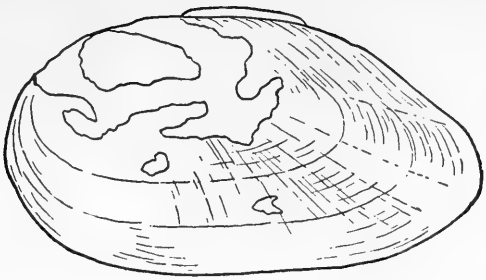

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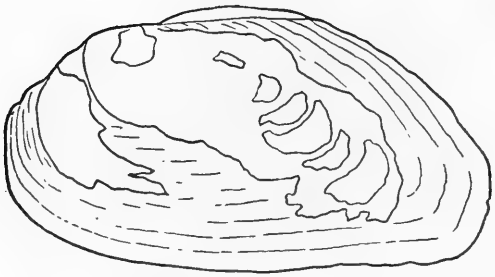

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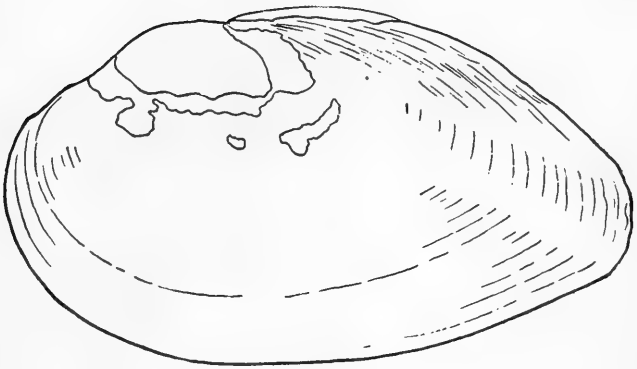

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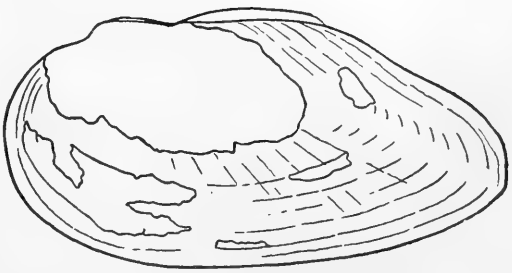

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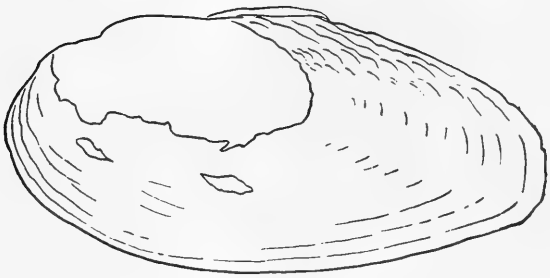

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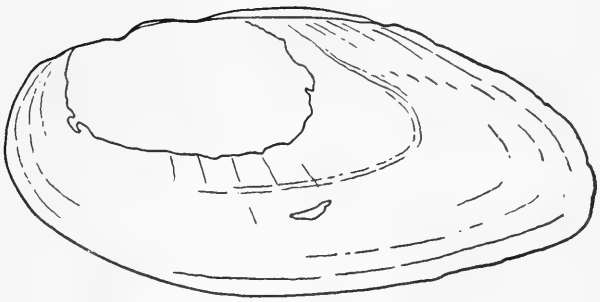

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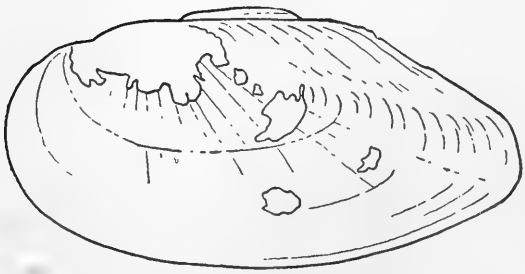

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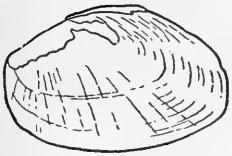

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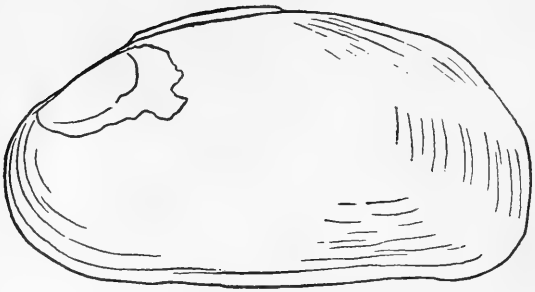

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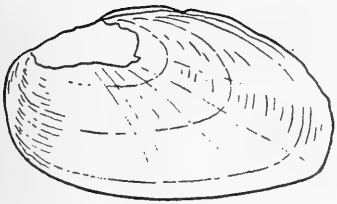

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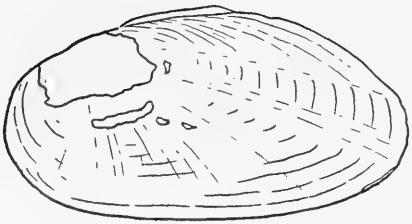

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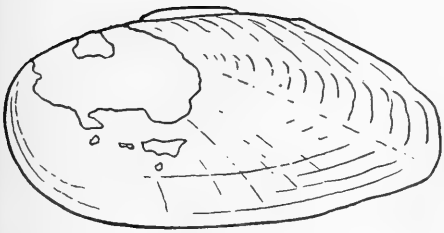

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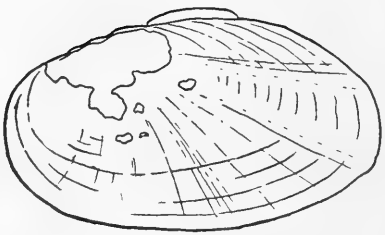

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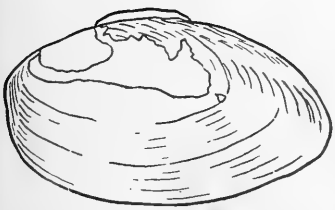

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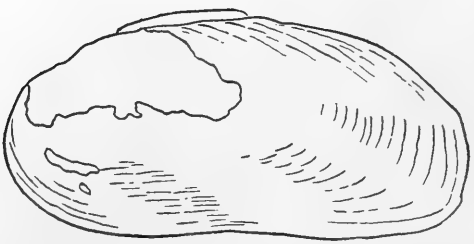

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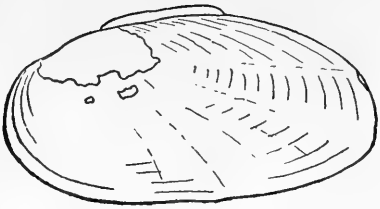

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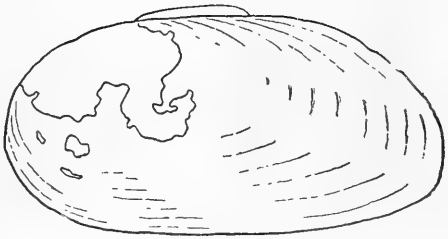

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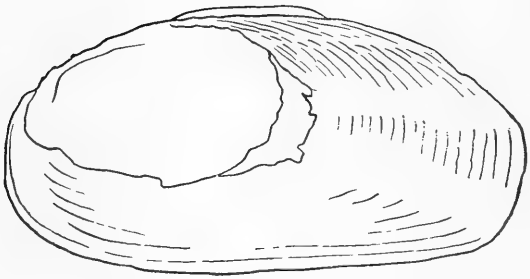

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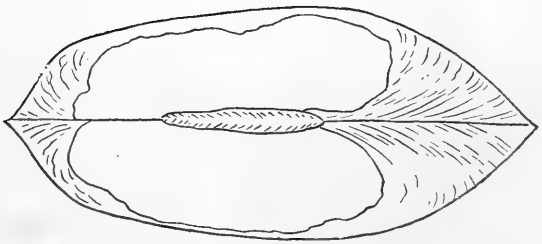

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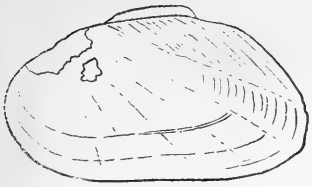

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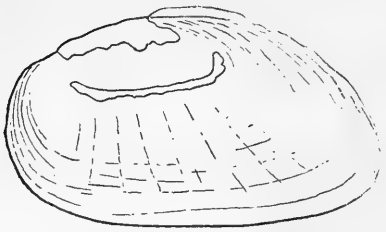

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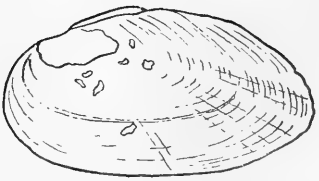

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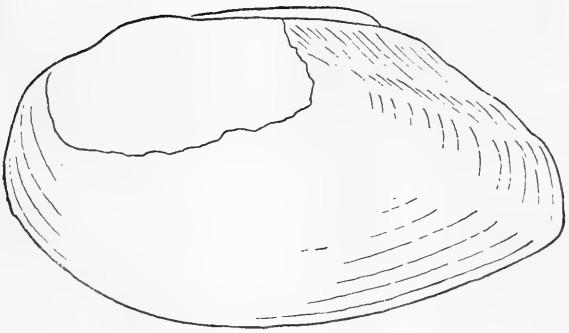

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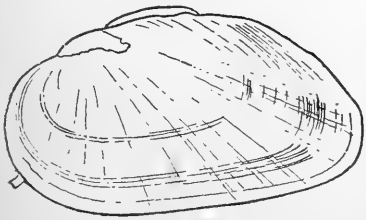

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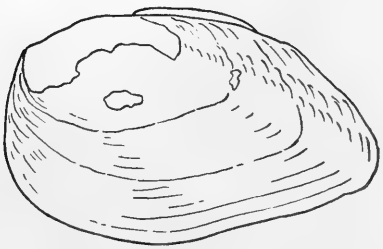

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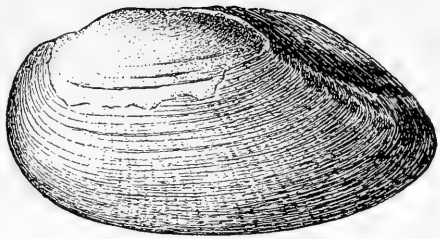

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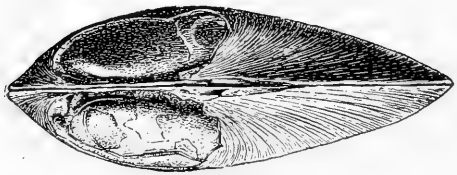

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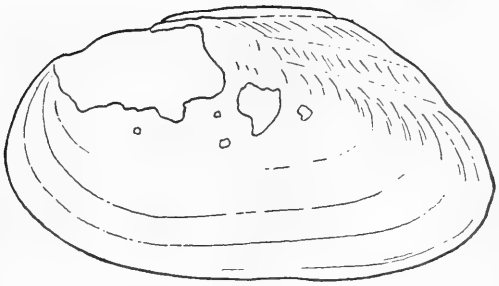

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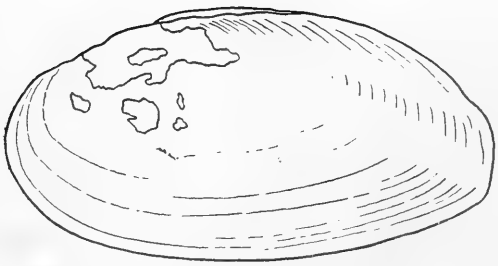

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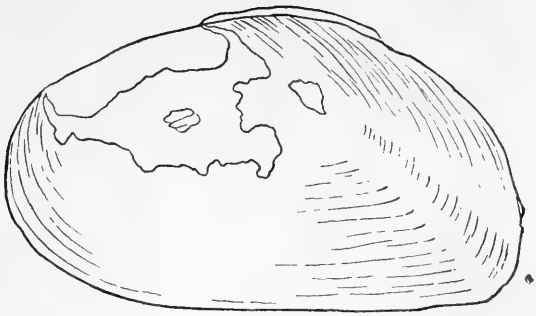

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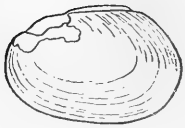

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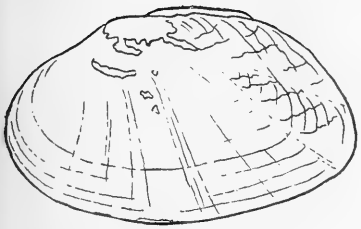

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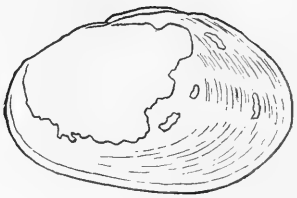

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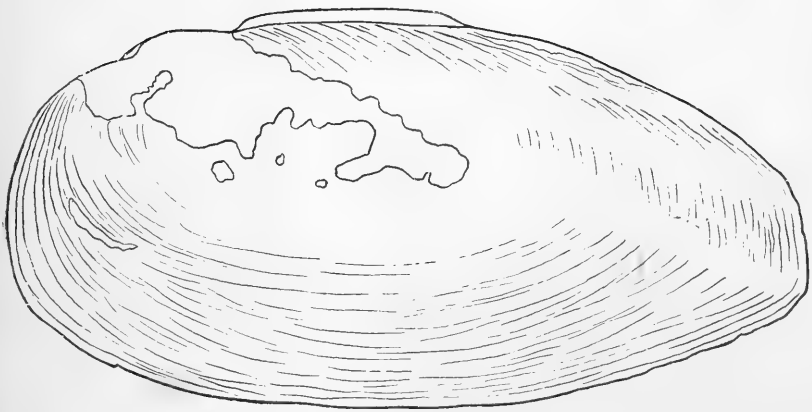

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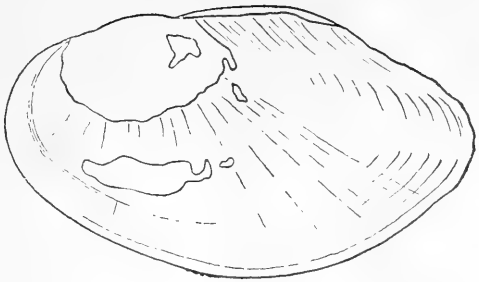

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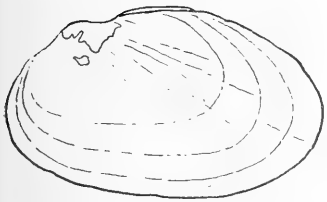

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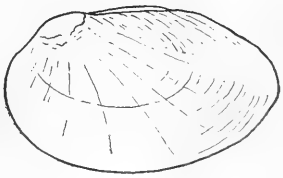

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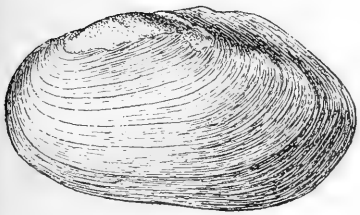

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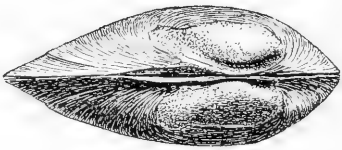

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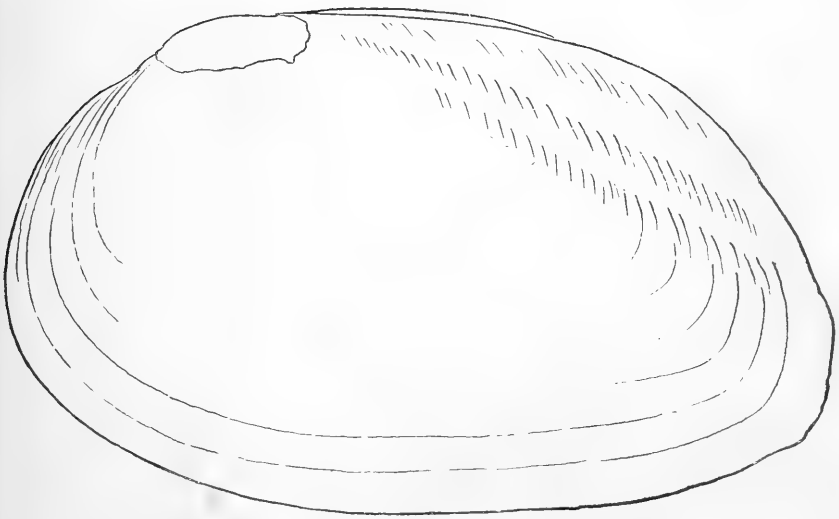

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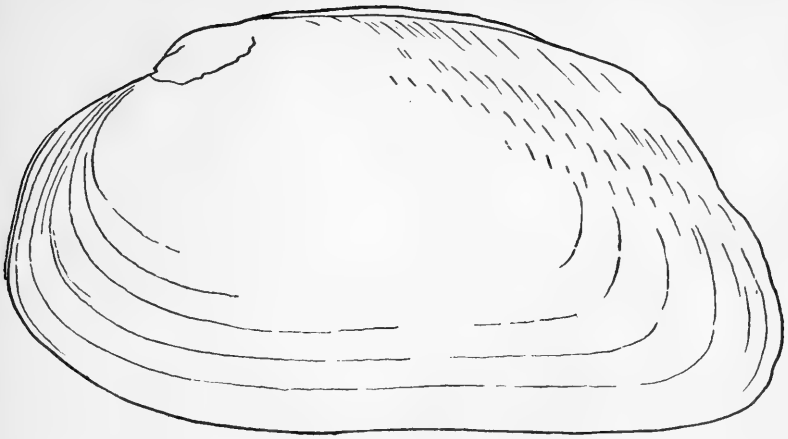

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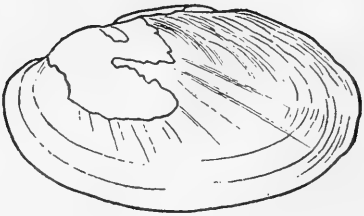

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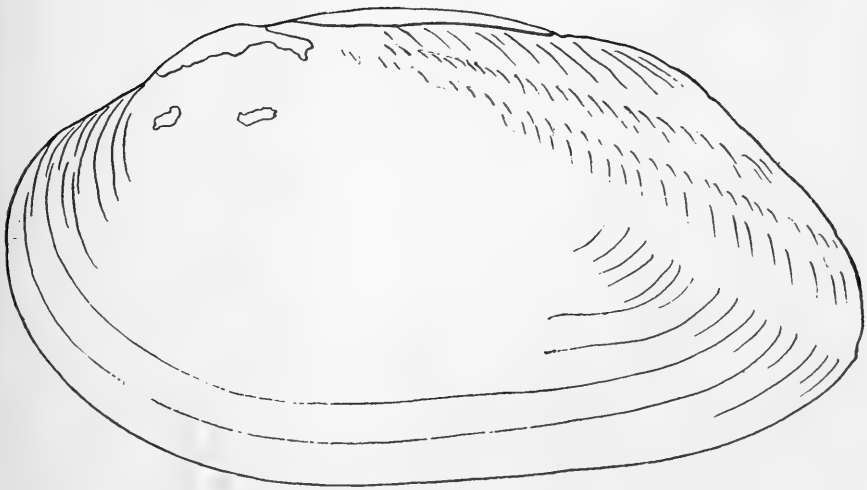

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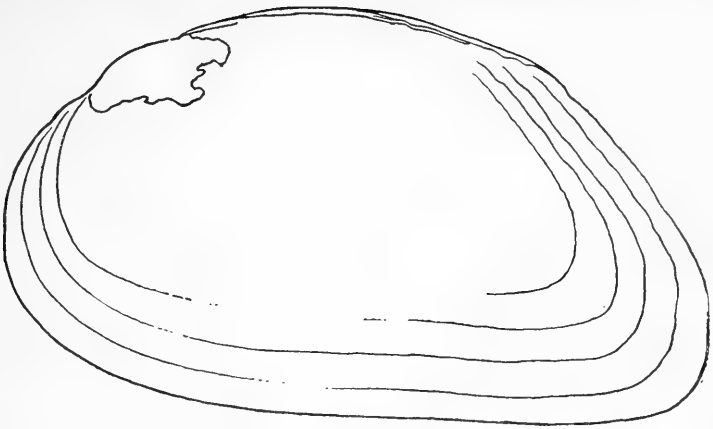

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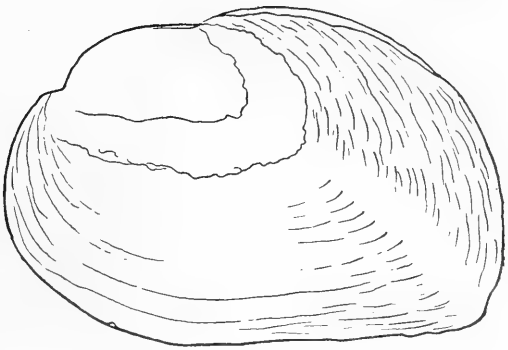

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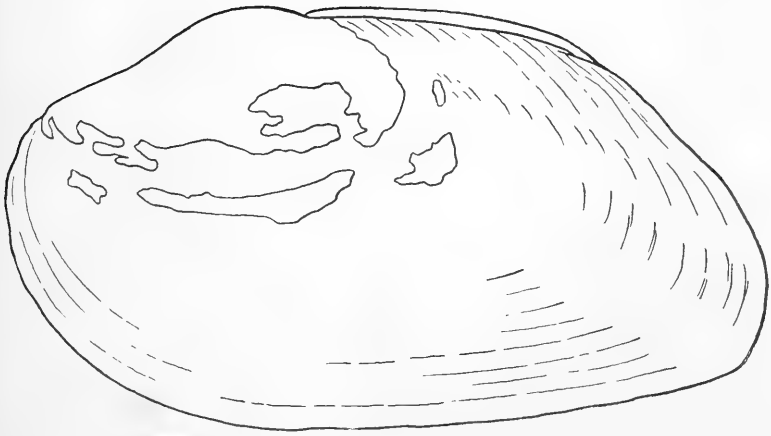

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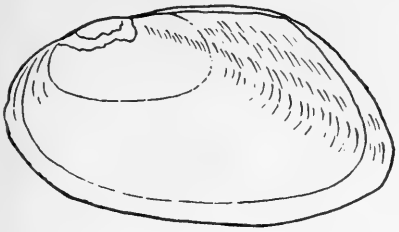

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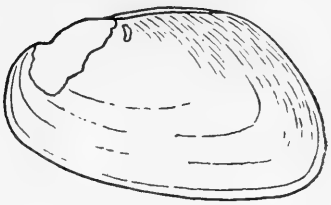

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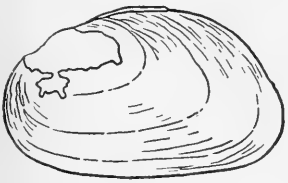

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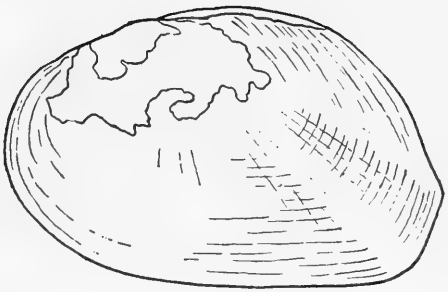

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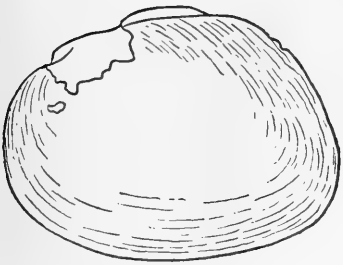

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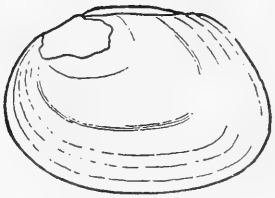

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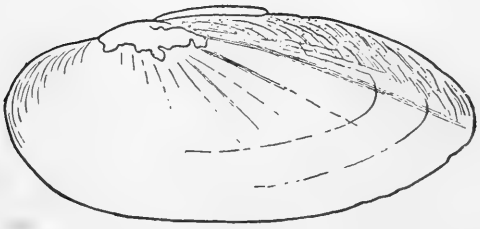

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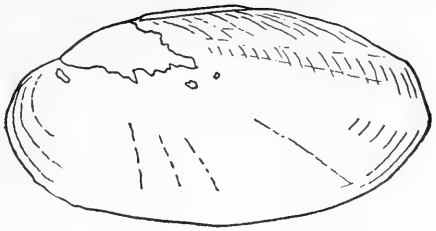

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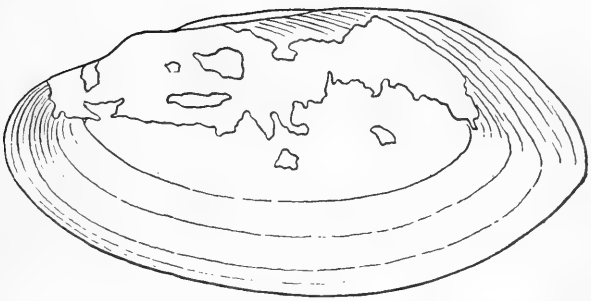

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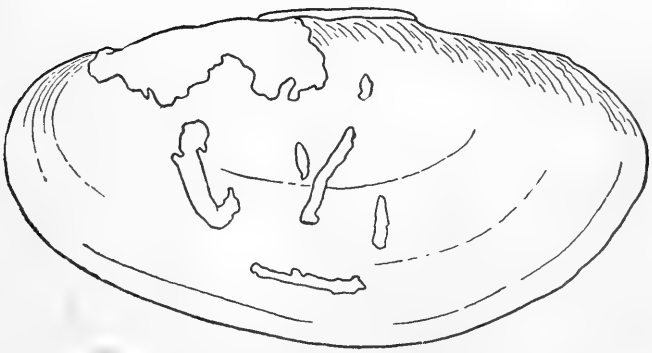

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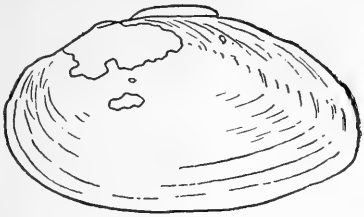

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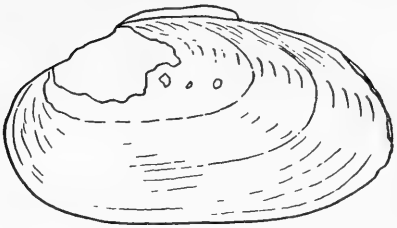

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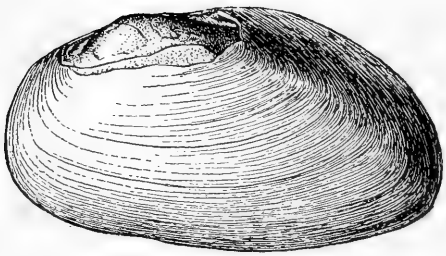

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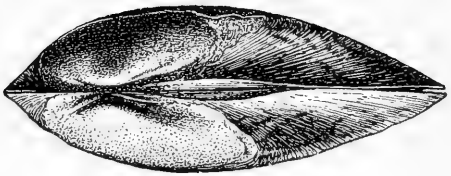

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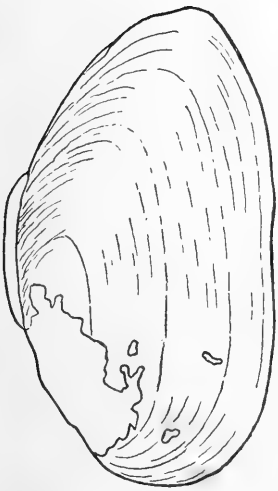

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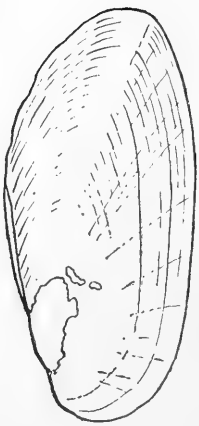

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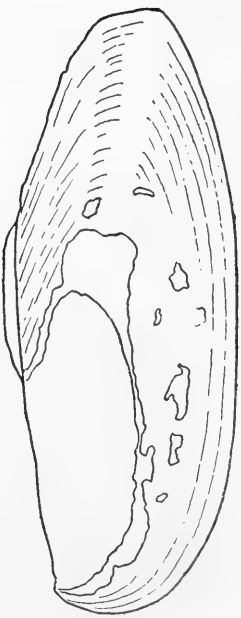

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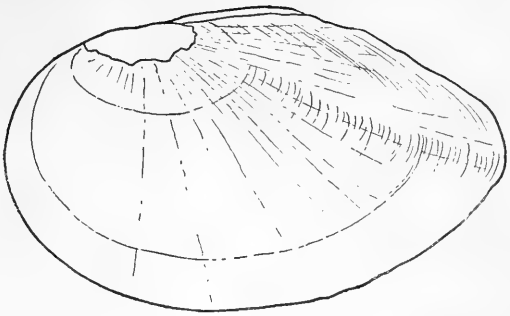

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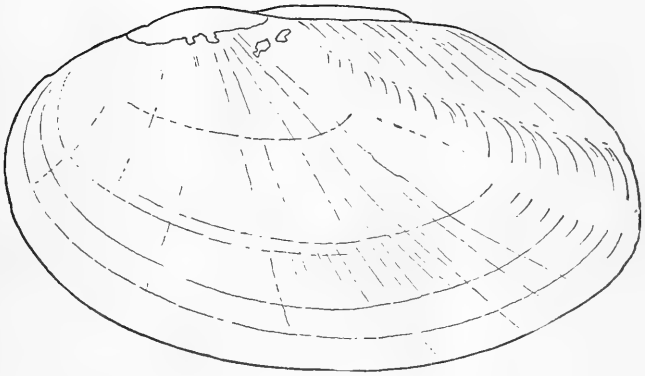

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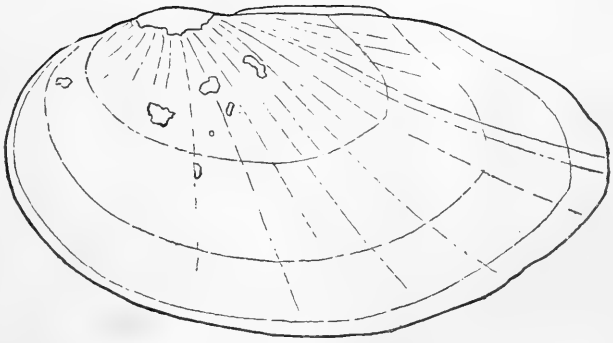

3

FLORIDA UNIOS.

ON A NEW SUBFAMILY OF PHYLLOSTOME BATS.

By

Harrison Allen, M. D.

I have concluded that *Natalus* should be removed from the Vespertilionidæ and should constitute a subfamily of the Phyllostomidæ. The characters of the Natalinæ are as follows: The nose-leaf absent in the adult, but rudimental in the late stage of the embryo. It forms an ovate elevation placed with long axis between the nostrils and reaches from the lip-margin to a short distance above the upper edge of the muzzle. A well-marked vertical line is seen in the third and fourth interdigital spaces, extending nearly their entire lengths. The vomer is produced and continuous with the crest of the basisphenoid bone; the sides of the mesopterygoid fossa are deeply concave. The ectoturbinal is a mere rudiment. Three premolars are present, both above and below, and six incisors below and four above, a wide interval separating the centrals. The cuboid bone projects plantarly; two phalanges are present in the third manal digit. The prosternum, first pair of ribs, and intercostal cartilages are co-ossified, much the same manner as in the remote *Hipposideros*. There is no terminal cartilage to the third manal digit.

The claim here made that the Natalinæ are related to the Vampyri-group of the Phyllostomidæ rests on the following statements: A rudiment of a nose-leaf, the median ridge of which persists, is seen in the late stage of the embryo. The premaxillæ are united on the palate; the premolars are large, displayed from within outward; the upper molars possess a well developed hypocone. The interdigital spaces are sharply defined proximally, and are without skin-folds on the ventral surfaces; the tragus is thickened on the inner border, and the external basal lobe lies within the conch. The sternum is keeled throughout. The ulna is provided with a shaft. The first metacarpal bone is flexed. These characters sharply separate *Natalus* from the Vespertilionidæ (Plecoti occasionally excepted). Some of the characters, such as the keeled sternum and fixed ulna, are found in other groups.

The long bones bear a close resemblance to those of Lobostomidæ (genera *Mormops* and *Chilonycteris*), and *Macrotus* among the Vampyri. The femur is quite similar, as seen in the flange on the inner side of the shaft near the head (best seen in *Mormops*) and in the backward posi-

tion of the trochanters. The bones of the first row of phalanges of the foot gradually increase in length from the second to the fifth as in Lobostomidæ. The loop of the superior semicircular canal of the auditory apparatus, as is the rule with the Phyllostomidæ, is not occupied with bone. The astragalus is slightly sigmoid, as in *Chilonycteris*.

The characters which Natalinæ enjoy in common with Vespertilionidæ are the presence of two phalanges in the third manal digit; three premolars in each jaw, and incisors in two pairs in the upper jaw. In the arrangement of the nerve lines in the fourth interdigital and in the shape of the second phalanx of the third manal digit the Natalinæ resemble the Emballonuridæ.

From *Noctilio* and Lobostomidæ the Natalinæ differ in the absence of an internal basal ridge to the auricle. The arrangement of the nerves in the fourth interdigital space is exactly as in *Chilonycteris*. The proportions of the phalanges of the fourth and fifth fingers are almost exactly the same as in the genus last named.

The Natalinæ resemble the genus *Plecotus* of the Vespertilionidæ in the flexion of the pollical metacarpal bone; in the wide second interdigital interspace; in the absence of a skin-fold at the proximal end of the

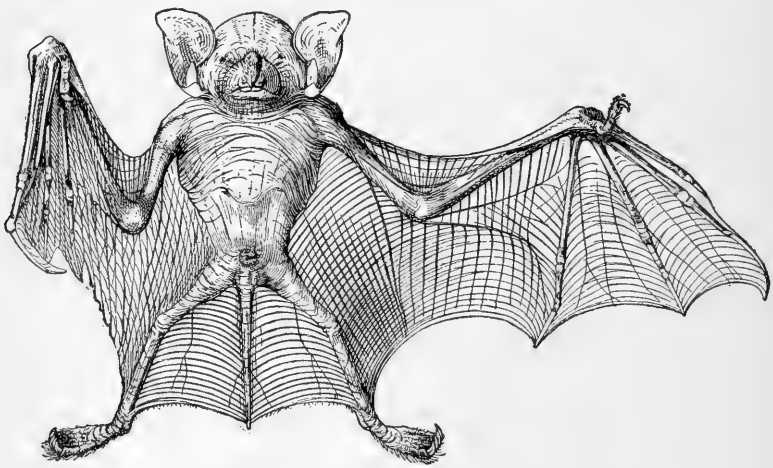

FIG. 1. Front view of an embryo of *Natalus stramineus*, showing rudimentary nose-leaf.

metacarpal bones, as well as in the absence of the accessory cartilage to the terminal cartilage of the fifth manal digit.

Two embryos were available for examination, both obtained from material in the Museum of the Academy of Natural Sciences of Philadelphia, collected by the late Mr. William M. Gabb in Santo Domingo. One of these specimens was oval, measured 25 millimeters in length and 15 in breadth. Length of head, 16 millimeters; foot, 9; thumb, 5. Sex apparently female. There was no trace of nose-leaf, the parts being quite the same as in the adult. The tragus was carried forward and laid on the cheek. It was simple and without the peculiarities of the adult.

The second specimen was larger than the first, and measured (the limbs being displayed), from crown to rump, 24 millimeters; length of head, 17 millimeters; foot, 9; thumb, 7. The tragus was erect and the peculiarities of the adult structures were beginning to announce themselves, though no hairs were present.

If the results obtained from the examination of the embryos be confirmed, *Natalus* presents a disposition for the integument at the muzzle to take on a different expression in the late form of the embryo or in the recently born, which is not found in an earlier stages of development or in the adult. Such a disposition is, so far as I know, unique, and it may be a temperate deduction to make that *Natalus* at no time bears a nose-leaf, but that the parts as seen in Fig. 1 in the late embryo are effects of shrinkage of the tissues under alcohol. Yet since *N. micropus* possesses an elevation at the top of the muzzle which is much the same in character as the form of *N. stramineus*, I have concluded to name the parts as they stand in the above diagnosis.

I have had an opportunity of examining both *Natalus stramineus* and *Natalus micropus*.

DESCRIPTION OF A NEW GENUS OF PHYLLOSTOME BATS.

BY

HARRISON ALLEN, M. D.

Mr. Frederick W. True, curator of the department of mammals, National Museum, has placed in my hands a skin in spirits of a small leaf-nose bat, believed to be from the vicinity of the Segovia River, Eastern Honduras. The specimen had been eviscerated and the skull removed. The lower lip was badly mutilated. From the characters furnished by the nose-leaf and the peculiar coloration of the fur, I believe the form to be a new genus allied to *Stenoderma*, and describe it as follows:

Ectophylla, new genus.

Nose-leaf erect, basal part notched in middle of free margin. Nostrils entire (but grooved continuous to outer margin of nose-leaf) separated by a small rounded nodule which apparently represents the lower part of the median leaf-crest, which otherwise is absent. Lateral gland-clumps rudimental, borne on the surface of a flat, scalloped skin-fold. Auricle as in *Hemiderma*, simple, erect, ovate; as measured from the crown it is shorter than the head. The single scallop begins abruptly at the middle of the moderately convex outer border. The external basal lobe convex and slightly thickened; basal ridge, or lappet, none. The internal basal lobe is rounded and free. Tragus almost one-half the height of the auricle, moderately convex on the inner margin, irregularly convex on outer, and furnished with two coarse serrations near the base. Lower lip mutilated. The mentum shows signs of having borne a row of eight (?) marginal rounded warts, and a small median one placed behind them. The lip apparently not cleft. Wings as in subfamily. Interfemoral membrane consists of a broad hem to the inferior extremity and pubis. Tail absent; tip of calcar projecting. The wing membrane reaches a point nearly midway between the ankle and the base of the metatarsi. The first phalanges shorter than the second. The first phalanx of the third finger about one-third the length of the corresponding metacarpal bone. The fifth metacarpal bone as long as the forearm. The phalanx of the second digit 3½ millimeters long, and equals about one-fourth the length of the corresponding metacarpal bone.

Ectophylla alba, new species.

Characters of the single species that of the genus. Above, the hair is of a dull whitish hue, and unicolored to the level of the shoulder. Through the rest of the back the hair is of a duller shade of white, except the tip, which is fawn. Below, the coloration is much the same as above, but the sides of the trunk, from the shoulders to the rump, are unicolored dark fawn, while the median part is whiter. Owing to the humeri being broken and the wing membranes distorted, it is

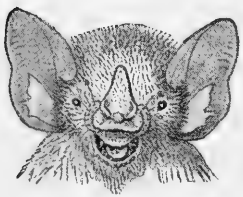

FIG. 1. Front view of head of *Ectophylla alba;* 1½ times natural size.

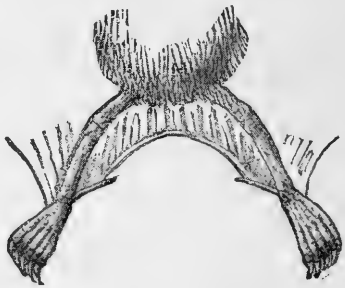

FIG. 2. Dorsal view of the inferior extremities and interfemoral membrane of *Ectophylla alba;* 1½ times natural size.

difficult to determine the exact distribution of the hair on the membrane. Below, unicolored dark fawn hair appears to extend outward as far as the elbow. The interfemoral membrane is naked.

Measurements.

	Millimeters.
Head and body (from crown of head to base of tail)	36
Length of arm	17
Length of forearm	25
First digit:	
Length of first metacarpal bone	3
Length of first phalanx	3
Second digit:	
Length of second metacarpal bone	21
Length of first phalanx	3½
Third digit:	
Length of third metacarpal bone	25
Length of first phalanx	9
Length of second phalanx	12
Length of third phalanx	6
Fourth digit:	
Length of fourth metacarpal bone	25
Length of first phalanx	7½
Length of second phalanx	8
Fifth digit:	
Length of fifth metacarpal bone	25
Length of first phalanx	6
Length of second phalanx	7
Length of head	14
Height of ear	10
Height of tragus	5½
Length of thigh	8½
Length of tibia	10
Length of foot	8
Width of interfemoral membrane from middle of rump	4

ON TEMMINCK'S BAT, SCOTOPHILUS TEMMINCKII.

BY

HARRISON ALLEN, M. D.

I have recently examined this form with some care and find it in close alliance with the genera *Atalapha* and *Dasypterus*. The number of the teeth is the same as in the genus last named. *Scotophilus* possesses but two upper incisors, placed at the sides of the canines. The upper molars possess a rudimentary hypocone. The shape and proportions of the last upper molar are almost precisely the same as in the atalaphines, viz., the tooth is composed of the anterior limb of the first V. A rudimental hypoconid characterizes the lower molars, and all cusps are blunted, *i. e.*, nonaciculate. The bicuspidate type of the much-crowded lower incisors is obscure in the first and second while absent in the third tooth. The transverse ridge of the outer surface of the tragus, the shape of the external basal lobe of the auricle, and the proportions of the digits are similar in *Scotophilus* and the American genera, and the markings on the wing membranes are of the same character, although more simple in the former. The ulna, in being confined to a fixed proximal rudiment without shaft, is also identical. The distal ulnar rudiment is of the quadrate-perforate type instead of being uncinate, as in the atalaphines (occasional examples in *A. noveboracensis* excepted). The pisiform is elongate and lies alongside of the proximal end of the fifth metacarpal bone.

Among the distinctive characters of *Scotophilus*, as compared with the atalaphines, may be mentioned the following: The mastoid process is trenchant and bold, almost as much so as in *Noctilio*, where this disposition attains its highest development. The temporal crest is high posteriorly. The nostril is circular and without disseptiment. The lower lip is provided with a triangular naked space, which is divided by a longitudinal groove. The thickened upper lip is separated from the muzzle by a faintly marked transverse groove.

As compared with *Nycticejus*, there may be said to be a general resemblance only. In *Scotophilus* the anterior palatal notch reaches a line which intersects the posterior margin of the premolar. The palate extends back beyond the middle of the zygoma. In *Nycticejus* the anterior palatal notch reaches barely to the hinder border of the canine. The palate extends to the anterior third of the zygoma. In addition to these characters, and as contrasted to *Scotophilus* and the atalaphines,

Nycticejus possesses a third upper molar which is almost a complete W, lacking indeed only the outer part of the hind limb of the second V. The lower molars have large hypoconids (in the first molar subequal to the proconid) and all cusps are markedly aciculate. The scarcely crowded lower incisors are tricuspidate throughout. Now, these characters in *Nycticejus* are much the same as in the Vesperugo group of vespertilionines, with which I incline to place it. It is to the northern fauna what *Rhogessa* is to the southern.

The coloration of *S. temminckii* is as follows: Above, the crown is of a dull-buff or dark-olive color. In one individual a buff spot was found back of the ears, but in these localities the buff is apical, the base of hair being dark brown. Elsewhere on the dorsum the base of the hair is of the color of the crown but occasionally darker, while the apical half is a rich olive brown. Toward the rump the basal and apical colors are not so well defined. Beneath, the fur is everywhere white or ash (in some individuals verging to fawn) and is uncolored.

It is likely that the olive-brown shades are best marked in the immature individuals and the buff shades in the fully adult. Five specimens were examined in all.

AN ANNOTATED CATALOGUE OF THE MAMMALS COLLECTED BY DR. W. L. ABBOTT IN THE KILIMA-NJARO REGION, EAST AFRICA.

BY

FREDERICK W. TRUE,

Curator of the Department of Mammals.

(With Plates LXXV–LXXX.)

Among the many African collections which Dr. Abbott has, with a generosity and an enlightened patriotism worthy of the emulation of other American travelers, presented to the National Museum, none are of more interest than the collection of mammals. This is the first collection of African mammals of any magnitude with which the Museum has been enriched, and it is greatly valued on that account; but it has in addition a high scientific value. The specimens have been prepared with much care, the skins being almost invariably accompanied by the skulls and furnished with labels giving the locality and date of capture, sex, and other data.

In determining the species I have found it necessary to depend almost exclusively on the literature, on account of the lack of specimens for comparison, but the identifications have been made with much care and may, I think, on the whole, be relied upon.

Several species apparently new are represented in the collection: *Dendrohyrax validus*, *Mus aquilus*, *Dendromys nigrifrons*, *Sciurus undulatus*, *Cephalophus spadix*.

On one who has studied the North American mammalian fauna in detail, the thought impresses itself that the condition of species, as regards variation, is different in the Ethiopian and Nearctic regions. In North America individual variation seems far less extensive than in Africa, while geographical variation appears to be more extensive and constant. In Dr. Abbott's collection great individual variation is especially apparent in the genera *Galago*, *Genetta*, and *Canis*. It is true that the species of the last-named genus everywhere present much individual variation, but in North America its chief variations appear to be geographical in character.

The known range of several species is considerably extended by Dr. Abbott's labors. Among the species whose range extends farther north than has apparently hitherto been suspected, may be mentioned the following: *Mellivora capensis*, *Canis mesomelas*, *Otocyon megalotis*, *Eliomys murinus*, *Otomys irrorata*, *Aulacodus swinderianus*, *Megaderma*

cor. The discovery of a new species of *Dendromys*, *D. nigrifrons*, extends the range of that genus from South Africa to East Africa.

The mammalian fauna of the Kilima-Njaro region, as indicated by Dr. Abbott's collection, and the lists published by Mr. Thomas and Capt. Willoughby, includes the following species, seventy-one to seventy-three in number:*

Colobus caudatus.
Cercopithecus albogularis.
Cercopithecus pygerythrus (T.–J.).
Cercopithecus sabæus.
Galago crassicaudatus.
Felis leo (T.–J.; W.).
Felis pardus (T.–J.; W.).
Felis serval (W.).
Cynælurus jubatus (W.).
Helogale undulata.
Herpestes gracilis.
Herpestes caffer.
Herpestes galera robustus.
Crossarchus mungo.
Genetta pardina.
Genetta tigrina (T.–J.; W.).
Viverra civetta (W.).
Mellivora capensis.
Hyæna crocuta (W.).
Hyæna striata (W.).
Canis mesomelas.
Canis lateralis (T.–J.; W.).
Canis sp.? (W.).
Otocyon megalotis.
Dendrohyrax validus.
Procavia brucei.
Eliomys murinus.
Mus arborarius.
Mus barbarus.
Mus aquilus.
Mus ? minimus.
Mus sp. ?
Dendromys nigrifrons.
Otomys irroratus.
Rhizomys splendens.
Sciurus undulatus.
Sciurus poensis.
Xerus rutilus.
Aulacodus swinderianus.
Lepus capensis.
Megaderma frons.
Megaderma cor.
Vesperugo nanus (T.–J.).
Nycteris thebaica.
Erinaceus albiventris.
Crocidura sp. ?
Connochætes taurinus albojubatus.
Oryx callotis.
Alcelaphus cokii.
Kobus ellipsiprymnus.
Strepsiceros kudu (T.–J.; W).
Strepsiceros imberbis (W.).
Tragelaphus scriptus roualeynii.
Æpyceros melampus.
Eleotragus ? arundinaceus.
Gazella grantii.
Gazella thomsonii.
Gazella wallerii (W.).
Cephalophus spadix.
Cephalophus mergens (W.).
Cephalophus nigrifrons.
Damalis hunterii (W.).
Neotragus damarensis.[1]
Neotragus kirkii (W.).[1]
Nanotragus moschatus.[2]
Nanotragus tragulus (W.).[2]
Oreas canna (W.).
Giraffa camelopardalis (W.).
Bubalis caffer.
Potamochœrus africanus.
Phacochœrus ælianii.
Equus burchellii (T.–J.).
Hippopotamus amphibius (W.).
Rhinoceros bicornis.
Elephas africanus (T.–J.; W.).

* Mr. Thomas's list of the mammals obtained or observed by Mr. H. H. Johnston is in the Proceedings of the Zoölogical Society of London, 1885, pp. 219–222. Capt. Willoughby's list is in his work on East Africa and its Big Game. The species mentioned in these lists, but not included in Dr. Abbott's collection, are in italics.

[1] Perhaps only one species is really found here.

[2] As in the preceding genus, I suspect that only one of these species belongs to the fauna.

CATALOGUE OF SPECIES COLLECTED BY DR. ABBOTT.

Colobus caudatus Thomas.

This remarkably handsome monkey is regarded by Mr. Thomas as a subspecies of *Colobus guereza*. So far as I know, however, no specimens showing external characters intermediate between those of the two forms have been found, and the skulls which Dr. Abbott brought home are different from that of *C. guereza*. On present evidence it may be affirmed that *Colobus caudatus* is a distinct species, peculiar to the region of Mount Kilima-Njaro.

The species would appear to be somewhat larger than *C. guereza*. The chief distinguishing character externally is the hairiness of the tail. The tail is clothed with long white hair from base to extremity, and resembles that of a horse, as is well shown in Mr. Thomas's figure.*

The differences between the skulls of the two species are many. The most striking relates to the form of the nasal bones, which are flat or even concave transversely in *C. caudatus*, so that they appear to lie in the same plane with the margin of the anterior nares when the skull is viewed in profile. In *C. guereza*, on the contrary, the nasals project strongly in the distal half. The interocular portion of the frontal is much narrower in *C. caudatus* than in *C. guereza*, the superior margin of the orbits is more arched and the forehead above them much more depressed. The facial portion of the skull in front of the eyes is broader and more convex in *C. caudatus* than in the allied species, and the external rim of the orbits narrower. The tympanic bones are much the largest in *C. caudatus*, and their form as well as the relative positions of the various foramina are different. The mandible is less deep and more shelving at the symphysis in *C. caudatus*.

Many of these differences are indicated in the accompanying table of measurements. They are sufficient, I am satisfied, to warrant the separation of *C. caudatus* from *C. guereza* as a distinct species, though the two forms are closely related.†

The largest skull of *C. caudatus* in the collection (No. 34680), which has a basilar length of 91.4 millimeters, has the suture between the occipital and sphenoid still open and the teeth very little worn.

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* Proc. Zoöl. Soc., London, 1885, pl. 12.

†I may say, in confirmation of this opinion, that when a skull of *C. guereza* was placed in the midst of five or six skulls of *C. caudatus* it was immediately selected from the others by three persons to whom the question at issue was unknown.

Dimensions of four skulls of Colobus caudatus compared with those of one skull of Colobus guereza.

Measurements.	*C. guereza*, 21729 ♂ adult.	*C. caudatus.* 34789* ♂ young Kahé.	34790 ♀ ad. Kahé.	34788* ♀ young Kahé.	34791† quite young Kahé.	34680 ♂ ad. Kahé.	34679 ♂ ad. Kahé.	34676 ♀ ad. Kahé.	34678 ♀ Kahé.	34677 ♀ jr. Kahé.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Basilar length (Hensel)	82.0	86.4	78.4	78.0	55.2	91.4	87.0	81.5	74.5	74.5
Length from posterior edge of palate to posterior edge of incisive alveolæ	47.5	48.2	45.2	42.8	30.0	49.0	48.0	43.5	39.5	39.9
Greatest breadth across zygomatic arches	80.0	78.9	74.2	74.6	58.2	83.0	78.0	73.3	70.0	71.0
Least width between the orbits	14.4	10.0	9.8	9.6	7.4	11.0	10.0	9.0	8.0	8.0
Longest axis of orbits	26.2	27.4	27.6	27.8	22.6	26.5	26.5	26.5	25.0	26.0
Length of nasals in the median line	15.6	12.8	11.0	12.4	11.7	12.5	14.0	12.0	10.5	11.0
Vertical diameter of anterior nares	21.2	25.0	23.2	22.8	15.6	25.0	24.0	22.0	22.7	20.5
Transverse diameter of anterior nares	13.6	15.8	13.4	14.2	9.4	16.5	14.7	12.6	11.3	12.0
Length of upper molars and premolars taken together	33.0	35.6	33.8	32.4	18.6	34.5	34.0	33.8	31.5	33.0
Length of lower molars and premolars	39.6	40.0	39.4	37.6	19.4	42.0	41.0	39.5	35.0	38.0
Length of crown of superior canine	21.4	.....	12.6	.....	.....	21.5	23.3	12.5	13.0	12.0
Length from posterior edge of lower incisive alveolæ to posterior margin of condyle of jaw	77.8	79.4	70.8	73.6	53.0	85.5	81.0	76.0	69.3	69.5
Depth of jaw below the coronoid process	46.8	48.0	43.0	45.8	31.0	52.3	50.0	49.0	44.5	46.5

*Suture between basi-occipital and basi-sphenoid open; permanent dentition. † Milk dentition.

Cercopithecus albogularis Sykes.

The three specimens collected by Dr. Abbott correspond to Sykes's and Fraser's description of *C. albogularis*, between which and the *C. monoides* of Is. St. Hilaire there seems to be no essential difference. St. Hilaire states that according to the English zoölogists the breast of *C. albogularis* is white. I do not find it so stated, however; the words in the original description are: "Chin and throat pure white."* Further, the quotation of the original description of the color of the species is not strictly accurate, and although St. Hilaire intimates that the thumb is longer in his *C. monoides*, his figure does not indicate that such is the case.

The largest specimen collected by Dr. Abbott is almost exactly of the same size as the type, if Sykes's measurements may be relied upon. The only discrepancy in color which I find relates to the hind legs (excluding the feet). Sykes states that they are "black, with a little of the dorsal color." In Dr. Abbott's specimens they are clear gray throughout, except at the knee, where there is a black area. This gray color arises from the fact that the hairs are black in the upper half, with two rings of white.

The young specimen (No. 18929) differs somewhat in coloration from the adults, which difference is doubtless due to immaturity. The white area on the throat is prolonged into a silvery gray area on the breast, and the general color of the belly is dusky gray rather than blackish, and the hairs are but little annulated with white. There is much whitish

*Sykes, Proc. Comm. Sci.. Zoöl. Soc. London, 1831, p. 106.

color and brownish silvery gray between the hind legs. The exterior of the hind legs is blackish, but the annulations of white, though not prominent, are perceptible. In a small area on the under side of the base of the tail and about the anus the hair is cinnamon red. There is a tinge of this color in the same region in the adults, but it is not conspicuous.

The skull of the largest specimen, compared with a skull of *C. mona*, shows many differences. The nasal region is much higher and more prominent. The anterior nares are much larger. The nasal bones themselves are longer and broader. The orbits are higher than broad, which is not the case in *C. mona*. The palate is longer and narrower, and the posterior palatine foramina, in this specimen at least, are situated opposite the posterior margin of the last molar, and not that of the penultumate molar, as in *C. mona*. The dimensions of this skull are as follows:

Dimensions of skull No. $\frac{34681}{18927}$, *male.*

	mm.
Basi-cranial length (Hensel)	71.5
Greatest length	104.0
Zygomatic breadth	68.0
Length of nasal bones	20.0
Breadth of nasal bones taken together anteriorly	10.0
Height of anterior nares	19.5
Breadth of anterior nares	10.5
Length of palate from alveolus of incisor to posterior emargination	36.5
Height of orbit	22.0
Breadth of orbit	20.0
Length of upper molar and premolar series	24.0
Length of lower molar and premolar series	30.0
Length of mandible, from right condyle to posterior margin of alveolus of incisor	69.0
Depth at the angle	37.0

This skull indicates that the individual to which it belongs is not young. The occipito-sphenoidal suture is closed and that between the squamosal and parietal bones is partially obliterated. The teeth are worn nearly to the roots in an irregular manner.

$\frac{18927}{34681}$. Male, adult. Taveta, March, 1888.
$\frac{18928}{34682}$. Female, nearly adult. Taveta.
18929. Male, young. Taveta.

Cercopithecus sabæus (Linn.).

The collection contains one young specimen from Taveta. It is apparently a male. It presents no peculiarities of coloration, except that the tail is dusky at the end rather than whitish, but it appears to have been injured during life, and has not its full length. The ears are clothed within with long whitish hairs, which extend beyond the margin of the ear.

The skull shows the milk dentition. All the sutures are open, except

the left half of the fronto-parietal, which, unlike its fellow, is nearly obliterated. The dimensions of the skull are as follows:

Dimensions of skull No. $\frac{34683}{18930}$, jr.

	mm.
Basi-cranial length (Hensel)	44
Greatest length	80
Zygomatic breadth	49
Length of nasal bones	13
Breadth of nasal bones taken together, anteriorly	4.5
Height of anterior nares	11
Breadth of anterior nares	6
Length of palate	22.5
Height of orbit	19
Breadth of orbit	18
Length of mandible	43.5

$\frac{18930}{34683}$. Male (?), young. Taveta, March 8, 1888.

Galago crassicaudatus (Blainville).

The three specimens collected are nearly of equal size. The dimensions of two of them are as follows:

Measurements.	18931. ♂	18932. ♂
	mm.	*mm.*
Head and body	286	297
Tail, with the hairs	305	345

The skins differ considerably in color. In No. 18931 the upper surface of the head and body, the tail, and the limbs are strongly tinged with rusty brown, while in No. 18932 these parts are gray, only lightly tinged with pale yellowish brown. The extremity of the tail of the former specimen is chocolate brown, and of the latter yellowish white. As these two individuals were taken in the same locality at the same date, and are both of one sex, it would appear that the difference in color is merely an individual character. The third skin, No. 18933, represents the gray phase.

Dimensions of three skulls of Galago crassicaudatus.

Measurements.	35091 18931* Male.	35092 18932 Male.	35093 18933 Female.
	mm.	*mm.*	*mm.*
Basi-cranial length (Hensel)	.....	53.5	51.5
Greatest length	.....	68	67
Zygomatic breadth	.....	44.5	44
Length of nasal bones	22	23	19.5
Length of palate	.....	25	25
Height of orbit	.....	19	18.5
Breadth of orbit	.....	17.5	18
Length of upper molar and premolar series	22	21	20.5
Length of lower molar and premolar series	21	21.5	21
Length of mandible	42	42.5	42

* Skull broken.

Dr. Abbott remarks on one of the labels that the species is common in the forest, and that the natives state that there are three other kinds in the same region, one larger and two smaller.

$\frac{18934}{35094}$. Male. Taveta, July, 1888.
$\frac{18933}{35092}$. Male. Taveta, July 20, 1888.
$\frac{18933}{35093}$. Female. Arusha Wa-cini, October 22, 1888.

Helogale undulata (Peters).

The two skins collected agree perfectly with Peters's description and figure, though the latter is too highly colored. The dimensions of the younger skin (No. 18934), which is the only complete one, are as follows:

	mm.
Length of head and body	215
Length of tail, with hairs	125

The hairs of the under surface of the tail in the older skin are nearly uniform red throughout, but in the younger skin they are annulated throughout with black, except at the base of the tail.

The dimensions of the skulls are as follows:

Measurements.	18934, ♀, jr.	18935, ♀ adult.
	mm.	*mm.*
Length *	46. 5	47
Breadth †	26	31
Palate length ‡	23	24
Palate breadth §	16. 5	16. 5
Incisors to cross line ‖	16	15. 5
Basi-cranial axis ¶	.....	.....

* For convenience of comparison I use here and in *Herpestes* the measurements given by Mr. Oldfield Thomas in his paper on the African Mongooses. (Proc. Zool. Soc., London, 1882, p. 65.) "Length"=Distance from front of premaxillæ to most posterior point of either occipital condyle.

† Greatest breadth across zygomata.

‡ From front of premaxillæ to end of bony palate.

§ Between the points at which the last premolar and first molar touch each other at the outer edges.

‖ From front of premaxillæ to a point midway between those mentioned under last heading.

¶ From central point of post. edge of basi-occipital to anterior edge of lower surface of præsphenoid.

The ratio between the breadth of the last premolar and last molar teeth, measured according to Mr. Thomas's system, is 72 per cent. for the adult skull (No. 35095), and 66 per cent. for the young skull (No. 35094). The difference is due to the wearing away of the last premolar in the older skull, which is here absolutely smaller than in the younger skull.

Dr. Abbott remarks that this species is common, living in holes in ant-hills.

$\frac{18834}{35094}$. Female, young. Plains east of Mount Kilima-Njaro, July, 1889.
$\frac{18835}{35095}$. Female, adult. Taveta.

Herpestes gracilis Rüppell.

The single specimen collected by Dr. Abbott appears unquestionably to belong to this species, although it agrees exactly with neither the descriptions nor the figures of the typical and other varieties. This is due probably to the indefiniteness of the terms used in the several

descriptions. The skin before me can scarcely be called gray, because the two colors apparent in the hairs do not mingle to form a tint. It is rather to be called grizzled. The grizzling is produced by the annulations of the longer hairs, which are alternately black and cream-colored, or pale buff. The hairs of the back have two or three light-colored rings, but about the base of the tail they have as many as five or six light rings. Besides these long hairs there is an underfur which is buff-colored in the upper half and dusky at the base. The tail is colored on both sides like the back, except in the terminal 3 inches, where it is black. The under surfaces of the body are buff-colored, with inconspicuous dusky annulations. The feet are like the back, but with more buff and less black.

The dimensions of the skull are as follows:

Dimensions of skull No. $\frac{34684}{18936}$ ♀ *ad.*

	mm.
Length*	64.5
Breadth	31.5
Palate, length	34.5
Palate, breadth	19.0
Incisors to cross-line	23.0
Basi-cranial axis	25.0

The ratio of the breadth of the last premolar to that of the last molar is 47.2 per cent.

$\frac{18936}{34684}$. Female, adult. Plains east of Mount Kilima-Njaro, June, 1889. (The mammæ contained milk.)

Herpestes caffer (Gmelin).

One adult specimen was obtained on Mount Kilima-Njaro, at an elevation of 5,000 feet. It agrees with normal specimens, except that the subterminal light rings of the hairs are yellowish rather than pure white, which gives the general color a yellowish tinge.

$\frac{19728}{35246}$. Adult female. Mount Kilima-Njaro, September, 1889; 5,000 feet.

Herpestes galera (Erxl.); var. **robustus**.

Two specimens were collected by Dr. Abbott on Mount Kilima-Njaro, an adult and a young individual. They are almost identical in color, except that the younger specimen has rather lighter underfur. The hairs are annulated throughout. There is no white to be seen on any part of the body, the annulations being light brown, of the same shade as the underfur, or paler, and the mark at the mouth also light brown.

The younger individual, which has the milk premolars in position, and the first true molar just appearing in the lower jaw, has a total length of 30 inches (752 millimeters), of which the tail is 10 inches (254 millimeters).

* These measurements are defined on p. 451, footnote to table.

Dimensions of the skulls.

Measurements.‡	35251. ♂ ad.	35252. ♀ jr.
	mm.	*mm.*
Length	104.9	.....
Breadth	56.2	.....
Palate-length	60.8	48.0
Palate-breadth	34.4	26.8
Incisors to cross-line	37.8	26.2

$\frac{19775}{35251}$. Male, adult. Mount Kilima-Njaro; November 8, 1889; 4,000 feet.
$\frac{19776}{35252}$. Female, young. Mount Kilima-Njaro; October, 1889; 5,000 feet.

Crossarchus mungo (Gmelin).

Dr. Abbott obtained a very large specimen of this striped mongoose. It is larger than any specimen thus far recorded, so far as I am aware. The head and body measure 18.5 inches (470 millimeters) along the curves, and the tail, with the hairs, 11.1 inches (282 millimeters.) These measurements are in the same proportion as those of the smaller specimens recorded by Mr. Thomas,* and probably, therefore, the greater size of the individual under consideration does not indicate specific distinctness. It is true that the relative size of superior premolar 4 and of molar 2 is not the same as in the specimens cited by Mr. Thomas, but the great range of variation in other species of *Crossarchus* in this particular, as shown by Mr. Thomas's measurements,† renders the character unreliable.

The teeth are very considerably worn in our specimen, which would appear to be past maturity. The coloration agrees with Mr. Thomas's description, except that the under surfaces of the body are tinged with yellow.

The dimensions of the skull is as follows:

Dimensions of skull No. $\frac{34685}{18937}$. ♀ *ad.*

	mm.
Length‡	74.5
Breadth	40.0
Palate, length	41.0
Palate, breadth	23.0
Incisors to cross-line	24.5
Basi-cranial axis	27.5
Length of premolar $\frac{4}{}$	7.7
Length of molar $\frac{2}{}$	5.9

$\frac{18937}{34685}$. Female, adult. Taveta.

*Proc. Zoöl. Soc., London, 1882, p. 90.
† L. C., p. 91.
‡ These measurements are defined on p. 451, footnote to table.

Genetta pardina I. Geoff.

Dr. Abbott collected the skins of six genets, which appear to belong to this species. Taken together they agree in nearly every particular with St. Hilaire's original description of this species and with F. Cuvier's figure.*

They present, however, certain extraordinary differences in coloration among themselves. No. 18939, from Taveta, and No. 19736, female, from Mount Kilima-Njaro (September, 1889, 5,000 feet), represent the two extremes. In the former the markings of the body and the dark rings of the tail are chestnut colored, and there is a tinge of this color over all the upper surfaces. The under surfaces of the body and of the light rings of the tail are nearly pure white. The lower legs and feet are isabelline, or pale buff, fading to white on the toes and the inside of the hind feet. Ten white rings can be counted on the lower side of the tail, the last being within half an inch of the tip.

In No. 19736 only the larger spots have chestnut centers, the rest being entirely black. The dark rings of the tail are also entirely black, and are joined together by narrow black lines, which extend across the light rings. The general color of the body is pale tawny, of about the same shade above and below. The outside of the lower legs and the feet, except the toes, are dusky brown, approaching black. Only seven light rings can be counted on the lower side of the tail and its terminal third is entirely black.

The remaining four skins present different intermediate conditions. Although the light-colored specimen described above is younger than the dark one, there is another light one quite as old as the latter, so that the difference does not appear to depend upon age. It is apparently a matter of individual variation.

The length of the six skins in their present dry condition is as follows:

Measurements.	18938, jr[1] [2] Taveta.	18939.[1] Taveta.	18940.[1] Taveta.	19737 ♀ Mt. Kilima-Njaro. ♀	19736 ♀ Mt. Kilima-Njaro. ♀	19735 ♀ Mt. Kilima-Njaro. ♀
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Length of head and body	475	505	580	535	580	550
Length of tail	405	435	450	465	430	455

[1] Light colored. [2] Third upper premolar and last molar not completely cut.

*St. Hilaire et F. Cuvier, Hist. Nat. des Mammifères. Plate: "*Genette panthérine.*" This great work is extremely defective from a bibliographical point of view. The plates are unnumbered and the pagination begins anew with every article.

The dimensions of three skulls, all from Taveta, are as follows:

Measurements.	35096, 18938 jr.	35097 ♀ 18939	35098 ♂ 18940
	mm.	*mm.*	*mm.*
Total length from front of premaxilla to occipital condyle	82.5	88.0	88.0
Basi-cranial length (Hensel)	75.5	82.0	81.0
Zygomatic breadth	42.0	44.0	45.5
Length of the palate from its post. margin to post. margin of incisors	36.0	38.0	39.0
Length of nasal bones in median line	17.0	17.0	17.0
Least breadth behind post-orbital processes	13.0	11.5	12.0
Length of superior molar and premolar series	28.0	28.0	28.0
Length of inferior molar and premolar series	31.0	30.5	30.5
Length of mandible from condylar extremity of ramus	56.0	57.5	59.5
Depth of mandible at coronoid processs	21.0	22.0	22.5

$\frac{18938}{35096}$. Male, young. Taveta.

$\frac{18939}{35097}$. Female. Taveta.

$\frac{18940}{35098}$. Male. Taveta.

19735. Female. Mount Kilima-Njaro, September, 1889, 6,000 feet.

19736. Female. Mount Kilima-Njaro, September, 1889, 6,000 feet.

19737. Female. Mount Kilima-Njaro, September, 1889, 6,000 feet.

Mellivora capensis (Schreber).

Dr. Abbott collected a single specimen of this species, on Mount Kilima-Njaro, and remarks that "it is rare upon the mountain."

19000. Male: Mount Kilima-Njaro, September, 1889, 5,000 feet.

Canis mesomelas Schreber.

The two specimens of this species agree well with Schreber's original description and Wagner's additions to the same, except in the following particulars as regards No. 18941: The black-tipped hairs of the dorsal mantle are continued down in front of the shoulders and across the under surface of the neck, giving this region a somewhat grizzled appearance which, however, is not so strong as on the shoulders. All the hairs of the tail are conspicuously black tipped, except those of a small area at the base of the tail underneath. The tawny color of the legs and flanks, which is very bright, is partially due to earth-staining.

18941. Male (?). Taveta.

19723. Mt. Kilima-Njaro.

Otocyon megalotis (Desmarest).

Dr. Abbott obtained three specimens of this animal—one from Taveta, and two from Arusha Wa-cini, south of the mountain. They differ from each other in color to a marked degree. The principal differences are as follows:

Female: Arusha Wa-cini, October, 1889, 2,500 feet. Underfur of the middle of the back dusky at the base, cream-colored above. Outer side of the legs and the feet chestnut brown. Backs of ears (except at the tip), extremity and dorsum of tail light brown. The pelage appears worn and faded.

Male: Arusha Wa-cini, December 2, 1889, 2,500 feet. General color pale. Backs of ears dusky, with white hairs intermingled. Outer side of legs and feet, dusky brown. Dorsum of tail black, which color extends to the extremity, but does not surround it, leaving the under side of the tail uniform creamy white. Pelage fresh and glossy.

18942. Taveta. Extremities of the underfur in the middle of the back with a strong, rusty tinge; tail similar. Backs of ears and outside of limbs, dusky brown. Dorsum of tail black, which color completely surrounds the extremity. Pelage rather harsh.

These differences appear to be partly seasonal and partly individual. In all the specimens the forehead and cheeks are nearly pure white and the muzzle dusky brown, making a much stronger contrast than is represented in the figure recently published by Mr. Mivart.*

The following measurements of the skull are the same as those employed by Prof. Huxley in his essay upon the cranial and dental characters of the Canidæ:†

Dimensions of a skull of Otocyon megalotis, No. $\frac{35099}{18942}$.

	mm.
Total length	112.0
Length of palate	56.0
Breadth of palate	27.5
Length of $\frac{pm.4}{}$	5.4
Breadth of $\frac{pm.4}{}$ in front	5.4
Length of $\frac{m.1}{}$	6.0
Breadth of $\frac{m.1}{}$	7.0
Length of $\frac{m.2}{}$	5.2
Breadth of $\frac{m.2}{}$	7.2
Length of $\frac{m.3}{}$	4.6
Breadth of $\frac{m.3}{}$	6.6
Length of $\frac{}{m.1}$	6.8
Length of $\frac{}{m.2}$	5.8
Length of $\frac{}{m.3}$	5.0
Length of $\frac{}{m.4}$	3.0
Basi-cranial length (Hensel)	101.0
Zygomatic breadth	63.0
Length of nasal bones in the median line	40.0
Length of superior molar and premolar series	35.0
Length of lower molar and premolar series	40.0
Depth of mandible at coronoid process (at right angles with axis of ramus)	38.0

The fourth superior molar is absent in this skull. In the proportions, shape, and position of the coronoid process, angle, and lobule of the mandible it differs from that figured by Prof. Huxley, and resembles more closely the skull figured by DeBlainville. These differences may be due to disparity in age.

The occurrence of this species in the Kilima-Njaro region is a matter

* Monogr. of the Canidæ, Pl. 45.

† Proc. Zool. Soc., London, 1880, p. 259.

of considerable interest, since, so far as I am aware, it has hitherto been found only in South Africa.

Dr. Abbott states that the native Kichaga name is *Kipara*.

19725. Female. Arusha Wa-cini, October, 1889, 2,500 feet.
19724. Male. Arusha Wa-cini, December, 1889, 2,500 feet.
$\frac{18842}{35099}$. Taveta.

Dendrohyrax validus True.*

PLATE LXXV.

Eight specimens appear to represent a distinct species of *Dendrohyrax*, which I have described for the first time in the place cited above. Dr. Abbott states that the native name of this animal is *Mha*.

The following is a repetition of the description:

Size large, form robust, muzzle hairy as far as the upper angle of the nostrils. The space between the nostrils, a narrow border external to them, and a line from them to the margin of the lip, are naked. The ears are of moderate size, rounded, and nearly concealed by the fur in the dry skins.

Fur dense, soft, and crenulate.

Color of the upper surfaces cinnamon-brown, strongly shaded with dusky brown or black, especially on the head. Feet dusky brown. Under surfaces pale, clear cinnamon. Dorsal spot russet-brown.

The majority of the hairs of the back are grayish chocolate-brown at the base, with a subterminal ring of bright cinnamon color, and tips dusky brown or black. Mingled with these are numerous longer, straight, shining hairs of a dusky brown or black color throughout. The subterminal rings of the hairs of the forehead and cheeks are paler than on the back, and these parts have therefore a grayish tint.

Around the nostrils and eye and on the feet the hairs are dusky brown. The ears are dusky brown externally, and have a tuft of yellowish white hairs on the upper part of the conch internally.

Hairs of the under surfaces grayish chocolate-brown in the basal half; terminal portion clear cinnamon-brown, varying to yellowish-white in some specimens, especially between the hind legs.

Skull depressed, muzzle elongate, nasal bones rectangular, slightly expanded posteriorly. Orbit completed behind by the union of the processes of the malar and frontal bones.

Coronoid process of the mandible rectangular, inclined forward, forming an angle of 45 degrees with the molars; its upper margin nearly in a line with the margin of the ramus posterior to the condyle.

Its nearest ally is *Dendrohyrax arboreus*, from which it differs in the color of the dorsal spot and of the under surfaces of the body. The skull appears to differ in many respects.

Compared with the skull of *D. arboreus* figured by Gray,† that of

* Proc. U. S. Nat. Mus., XIII, 1890, pp. 227–229.

† Gray. Hand-list of Edentate, Thick-skinned and Ruminant Mammals, 1873, Pl. 13, Fig. 2.

D. validus has the orbit more elongate. The postorbital processes, completing the orbit, are inclined forward rather than backward. The postero-external projection of the nasal nearly or quite separates the frontal from the maxillary, and thus usually touches the lachrymal. The portion of the malar forming the anterior rim of the orbit does not reach the lachrymal. The exoccipital process projects vertically downward and is hollowed out externally. In the younger skulls a large irregularly pentagonal interparietal bone is apparent.

The skins present almost no differences of color among themselves, except that some are a little paler throughout. The young individual has very soft wavy fur, of the appearance of underfur, pale yellowish brown except at the ends. A small number of long black hairs are intermingled. The dorsal spot is very pale yellow-brown, not very different from the general color of the fur.

*Dimensions of the body.**

Cat. No.	Locality.	Sex.	Head and body.	Fore foot.	Hind foot.	Ear from the occiput.
			mm.	*mm.*	*mm.*	*mm.*
18986†	Mount Kilima-Njaro	♂	513	45	64	14.5
18987	Taveta		588	46	59	12.5
18989	Taveta		470	42	58	15.5
18988	Taveta		520	48	64	13.5
18990	Taveta		500	42	59	13.0

*Taken from the dry skins, and therefore only approximately correct. † Collected June 17, 1888.

Dimensions of skulls.

Measurements.	34721* 18986 Mt. K.	34972† 18987 Taveta.	34969‡ 18988* Taveta.	34971‡ 18990* Taveta.
	mm.	*mm.*	*mm.*	*mm.*
Greatest length from premaxilla to occipital crest	95.0	95.0	95.5	98.0
Basilar length, from premaxilla to occipital condyle	89.5	87.0	90.0	93.5
Premaxilla to posterior end of palate	49.0	47.5	50.0	50.5
Greatest breadth of skull	51.0	48.0	52.0	52.5
Greatest length of nasals	25.0	25.5	26.5	28.0
Breadth of nasals (taken together) at distal end	12.0	10.6	13.0	12.5
Breadth of nasals at proximal end	19.0	20.5	20.0	19.5
Distance between extremities of postorbital processes of frontal	42.0	39.2	44.7	42.0
Length of molars	34.0	33.0	34.0	34.0

* Last molar just in position. † Last molar below the gum.
‡ Last molar in position and considerably worn.

$\frac{18986}{34721}$. Male adult. Mount Kilima-Njaro, June 17, 1888. (Type.)
$\frac{18987}{34972}$. Adult. Taveta.
$\frac{18988}{34969}$. Adult. Taveta.
18989. Adult. Taveta.
$\frac{18990}{34971}$. Adult. Taveta.
19726. Male, adult. Mount Kilima-Njaro, December 7, 1889. 6,000 feet.
19722. Female, adult. Mount Kilima-Njaro, December 7, 1889. 6,000 feet.
19727. Male, young. Mount Kilima-Njaro, December 23, 1889. 5,000 feet.

Procavia brucei Gray. (?)

A single skin of a true *Procavia*, collected by Dr. Abbott, appears to belong to this species. In the skull the elements of the occipital bone have not coalesced, but Dr. Abbott notes on the label that the uterus contains one nearly mature fœtus.

The upper surfaces of the body are rather pale yellowish gray, and the under surfaces white. The hairs of the back are black at tip, below which is pale yellow ring, succeeded in turn by a second black ring. The remaining portion of the hairs is pale brownish gray. The hairs of the under surfaces are pure white to the roots. The feet are pale silvery brown. The ears are similar, but grayer, and have a tuft of yellowish white hairs near the upper margin within. There is a similar light area over the eye.

The skull, as already stated, indicates that the individual is young. The last molar, both above and below, has not pierced the gum.

"The uterus contained one fetus nearly at term. Placenta zonary. Stomach contained chewed leaves and bark, and had thick, muscular walls.

"The specimen was shot among the lava blocks of an ancient lava stream. Several others were seen."—Abbott.

$\frac{18994}{34722}$. Female. Foot of Kyalu Mountains, near Mount Kilima-Njaro, June 24, 1889.

Eliomys murinus (Desmarest).

Of this species three skins and four specimens in alcohol (Nos. 19761–64) were obtained. Dr. Abbott remarks on one of the labels: "Male and female taken from a nest containing four young ones. Nest globular, about 5 inches in diameter, with a hole in the inside. It was situated in a bush five feet from the ground. The nest was made of grass and strips of banana fronds, and lined with fine grass."

The following measurements are given by Dr. Abbott:

	Inches.	mm.
Length of body*	3⅞	98.40
Length of tail to end of hairs*	4	101.60
Length of body†	3⅞	98.40
Length of tail to end of hairs†	4⅛	104.80
Length of body‡	3¾	95.25
Length of tail to end of hairs‡	3¾	95.25

Mus arborarius Peters.

Three skins and a number of alcoholics from Kilima-Njaro appear to represent this species. The under surfaces are entirely white, the upper surfaces tawny, and the ears rust-colored. The tawny-tipped hairs of the back are of two kinds, the one soft and fine, the other coarse and pre-

*19730. Male. Mount Kilima-Njaro, Nov. 16, 1889, 5,000 feet.
†$\frac{19729}{35724}$. Female. Mount Kilima-Njaro, No. 16, 1889, 5,000 feet.
‡19731. Male. Mount Kilima-Njaro, Nov. 16, 1889, 5,000 feet.

senting the appearance of grooved bristles when examined with a lens. Mingled with these hairs are numerous longer on of a black color.

The extremity of the tail is sufficiently covered with hairs to hide the scales.

The skins agree in every respect with Peters's description,* except that the feet appear to be somewhat shorter, measuring about 21 millimeters.

19718. Female. Mount Kilima-Njaro, December 26, 1889, 5,000 feet.
$\frac{19716}{35243}$. Female. Mount Kilima-Njaro, November 14, 1889, 4,000 feet.
19717. Male. Mount Kilima-Njaro, November 7, 1889, 5,000 feet.
19756. Female Mount Kilima-Njaro, 1889. (Alcoholic.)
19757. Male. Mount Kilima-Njaro, 1889. (Alcoholic.)
19758. Male, young. Mount Kilima-Njaro, 1889. (Alcoholic.)
19759. Male, young. Mount Kilima-Njaro, 1889. (Alcoholic.)

Mus barbarus Linné.

These specimens present a singular general resemblance to those of *M. arborarius*. The tail, feet, and ears are of the same color as in that species, and the fur is partly made up of fine channeled bristles. They are conspicuously different in the color of the back, which has the rows of light spots characteristic of *M. barbarus*. The median dark line is nearly or quite without the rusty-tipped hairs by which the color of the lateral dark bands is varied.

The thumb and fifth finger are rudimentary.

Dr. Abbott notes on one of the labels that the species is common.

Dimensions of a specimen preserved in alcohol. No. 18996. ♀

	mm.
Length of head and body	82.0
Length of tail	94.5
Length of hind foot (with claw)	27.0
Height of ear from crown of head	12.0

$\frac{19711}{35241}$. Male. Mount Kilima-Njaro, November 7, 1889, 5,000 feet.
19712. Male, young. Mount Kilima-Njaro, November 14, 1889, 5,000 feet.
18996. Female. Taveta. (Alcoholic).
19738. Female. Mount Kilima-Njaro, 1889. (Alcoholic.)
19739. Male. Mount Kilima-Njaro, 1889. (Alcoholic.)
19740. Male, young. Mount Kilima-Njaro. (Alcoholic.)

Mus aquilus sp. nov.

The collection contains a single apparently adult specimen of a medium-sized mouse, with the dentition of the typica subgenus *Mus*, but of rather peculiar general appearance. According to the label, the mouse was procured on Mount Kilima-Njaro at an elevation of 8,000 feet. It had been killed by a hawk. I have been unable to associate it with any recognized species, and will therefore describe it under the name of *Mus aquilus*.

*Reise nach Mossambique, 1852, p. 152, Pl. 36, Fig. 2; Pl. 35, Fig. 7.

Description.

Size intermediate between *Mus musculus* and *Mus decumanus*. Ears moderate, broad; toes 5–5. Fore feet with long, slender, little-curved claws. The thumb is armed with a short, stout claw—not with a nail, as is usual in this genus. Palms with five large tubercles.

Hind feet moderate, with rather large, stout claws. Soles naked. Second, third, and fourth toes subequal and longest; first and fifth much shorter.

Tail shorter than the body,* not sufficiently well clothed with hairs to conceal the scales.

Naked portion of the muzzle confined to a small area between the nostrils; the two halves of the same divided by a line of hairs.

Fur of the throat and chin directed forward; in all other parts, backward.

The fur is moderately harsh. When examined with a lens it is seen to be composed almost exclusively of coarse, flat hairs, with a few fine ones intermingled.

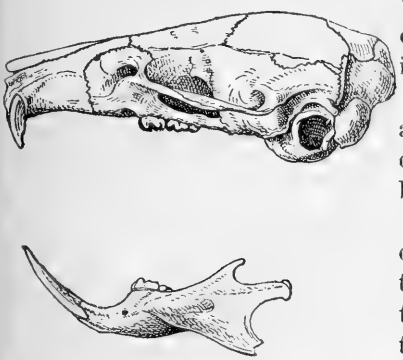


FIG. 1.—*Mus aquilus* True. Skull, enlarged; U. S. Nat. Mus. No. 34723. Type.

General color above dusky brown and below cinnamon. Feet and tail dusky. All the hairs are pale sepia brown at the base.

Those of the upper surfaces are dusky at the tip, with a single subterminal ring of cinnamon, except on the rump and muzzle, where the subterminal ring is wanting.

Feet, ears, and tail dusky brown. Hairs of the under surfaces throughout tipped with clear, pale cinnamon. There is a tinge of this color on the inner side of the hind feet proximally.

Skull slender (Fig. 1); muzzle depressed, elongate; zygomatic arch straight, not curved downward in the center. Infraorbital foramen large; the anterior margin of the root of the malar inclined outward. Incisive foramina long, expanded in the center. Palate ending in a projection, or tubercle, below the general level. Coronoid process of mandible moderate. Angle short and directed obliquely downward.

Dimensions of the dry skin.†

	mm.
Length of head and body	102.0
Length of tail	55.0
Length of hind foot and claw	23.0
Length of ear from the occiput	13.0
Length of longest fore claw	4.6
Length of longest hairs of the back	13.5

* From the uneven appearance of the extremity of the tail it is possible that a small portion is missing.

† These dimensions must, of course, be considered only approximately correct.

Dimensions of the skull, No. 34723 ♂. *

	mm.
Zygomatic breadth	15.0
Length from post. margin of alveolus of incisor to end of palate	12.6
Length of incisive foramina	6.6
Greatest breadth of incisive foramina taken together	2.6
Length of nasals	11.9
Breadth of nasals distally	2.6
Length of upper molars	4.8
Length of lower molars	4.4
Depth of mandible at coronoid process	7.8

$\frac{18997}{34723}$. Young. Mount Kilima-Njaro, April 11, 1888, 8,000 feet. (Type.)

? Mus minimus Peters.

A single alcoholic specimen belonging to the subgenus *Nannomys* is in the collection. It appears to represent this species, although the dimensions of the body are not exactly the same. It is not in a good state of preservation. I have made the following measurements:

	mm.
Length of head and body	55.6
Length of tail vertebræ	45.4
Length of hind foot (with claw)	12.6
Length of ear from the occiput	7.0

19750. Male, adult. Mount Kilima-Njaro, 1889. (Alcoholic.)

Mus sp.

There are specimens of two additional species of true rats in the collection which I have been unable to identify. One species resembles an overgrown house mouse, *M. musculus*. The other is smaller and is of a clear-gray color, with a pale yellow lateral line, and the tips of the hairs below pure white. The feet are also white and the tail dark and almost without hairs. The dimensions of an alcoholic specimen of this latter species are as follows:

Measurements, ♂, No. 19760.

	mm.
Length of head and body	82.8
Length of tail (with hairs)	103.?
Length of hind foot (with claw)	24.0
Length of ear from the occiput	16.4

$\frac{19713}{35242}$. Female. Mount Kilima-Njaro, November 24, 1889, 5,000 feet. (Skin.)
19714. Male. Mount Kilima-Njaro, November 24, 1889, 5,000 feet. (Skin.)
19715. Male. Mount Kilima-Njaro, November 10, 1889, 5,000 feet. (Skin.)
19760. Male. Mount Kilima-Njaro. (Alcoholic.)

Dendromys nigrifrons sp. nov.

The collection contains several specimens of a very small *Dendromys*, which does not appear to have been described hitherto. The most striking difference between this animal and the species described by Smith and Heuglin consists in the presence of a large black spot on the forehead, and I have therefore chosen for it the name of *Dendromys nigrifrons*.

* The skull is defective below and the total length cannot, therefore, be given.

Description.

Form stout. Muzzle broad. Ears broad and rounded; more than half as long as the head. Tail longer than the head and body,* slender, scaly; sparsely clothed with short hairs, which are not sufficiently numerous to conceal the scales. Legs slender. Fore feet moderate; second, third, and fourth toes subequal, the third being the longest. Thumb and fifth finger rudimentary, reduced to mere tubercles and furnished with nails; the other toes furnished with moderate claws. Hind feet long and slender. Third and fourth toes equal and longest; second slightly shorter; first very short, reaching only to the base of the second; fifth reaching to the proximal end of the terminal phalange of the fourth; first and fifth toes furnished with nails, the others with moderate claws. Soles naked and smooth, except at the base of the toes, where they are granular. The under surface of the toes is also granular, especially that of the hallux. Mammæ: Two pairs inguinal; one pair pectoral.

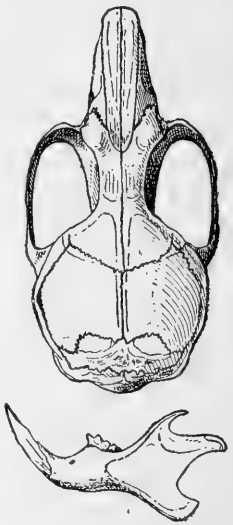


FIG. 2. Dendromys nigrifrons True. Skull, enlarged. Typical specimen.

Color above rusty brown, strongly shaded with black. A broad black spinal band from the nape to the root of the tail. A large black area on the forehead, not continuous with the spinal band. Under surfaces white, tinged with yellowish brown.

Hairs of the back dark plumbeous at the base, with a broad subterminal ring of yellowish brown, and black tips. Those of the spinal band and dark area of the forehead without the subterminal brown ring. Hairs of the under surfaces light plumbeous at the base, with long yellowish-white tips. Those of the throat and chin entirely white.

A white spot is situated at the base of the ears. A dusky ring encircles the eyes, and from thence a broad dusky band extends to the nose on each side.

Ears black, with a narrow fringe of white. Feet white. Tail dusky brown, unicolor, sparsely clothed with dusky brown hairs.

Dimensions of two alcoholic specimens.

Measurements.	19783. ♀	19782. ♂
	mm.	*mm.*
Length of head and body	63.2	58.4
Length of tail	69.0	59.0
Length of hind foot and claw	16.8	17.1
Length of ear from the occiput	10.7	11.6

* It is a little shorter in one specimen. See measurements, p. 464.

Dr. Abbott gives measurements of two of the skins on the labels, as follows:

Measurements.	19778. ♂ Mt. Kilima-Njaro.		19779. ♀ Mt. Kilima-Njaro.	
	in.	*mm.*	*in.*	*mm.*
Length of body	2¾	70	2¾	70
Length of tail	2⅝	67	3	76

The dimensions of the skull of one of the alcoholic specimens, No. $\frac{35263}{19783}$, are as follows:

	mm.
Basi-cranial length (Hensel)	14.6
Greatest zygomatic breadth	10.3
Length of nasals	7.4
Length of superior molars	3.2

19777. Male. Mt. Kilima-Njaro, November 15, 1889, 5,000 feet. (Skin.)
19778. Male. Mt. Kilima-Njaro, November 15, 1889, 5,000 feet. (Skin.)
19779. Female. Mt. Kilima-Njaro, November 16, 1889, 5,000 feet. (Skin.)
19782. Male. Mt. Kilima-Njaro, 1889 (?). (Alcoholic.)
$\frac{19783}{35263}$. Female. Mt. Kilima-Njaro, 1889 (?). (Alcoholic.)

Otomys irroratus (Brants).

A young specimen of this species, which has the teeth but very little worn, differs from the adults only in being a little browner and having more numerous long hairs.

The posterior upper molar has 7 laminæ, including the posterior small triangular one.

Dimensions of two skulls.

Measurements.	$\frac{35245}{19721}$ ♀ adult.	$\frac{34724}{18998}$ young.
	mm.	*mm.*
Greatest length	40.0	29.2
Basi-cranial length (Hensel)	32.2	23.6
Zygomatic breadth	20.2	.....
Length of nasals	18.0	10.0
Greatest breadth of nasals	8.4	5.4
Length of upper molars (alveoli)	9.4	8.6
Length of lower molars	8.2	8.0

$\frac{18998}{34724}$. Young. Mount Kilima-Njaro, June 8, 1888, 5,000 feet.
19773. Male. Mount Kilima-Njaro, November 7, 1889, 5,000 feet.
19774. Male. Mount Kilima-Njaro, November 14, 1889, 4,000 feet.
$\frac{19721}{35245}$. Female. Mount Kilima-Njaro, November 7, 1889, 5,000 feet.

Rhizomys splendens Rüppell.

Six specimens, taken at the same time in one locality, exhibit great differences in color due to age. The young male, No. 19001, in the skull of which the last molar is barely in position and all the sutures are open, is black throughout, except for a slight tinge of pale cinnamon on the hinder part of the back. In the females, Nos. 19002 and 19003, which are adult but apparently not old, the head is entirely black, and there is a broad black band on the back reaching nearly to the tail. The adult males, Nos. 18999 and 19000, have dark heads, but not strongly

pronounced spinal stripe; while in No. 19004, which is the largest and apparently the oldest of the series, the head is dusky only between the eyes and nose, the rest of the head and the back and sides being bright cinnamon color.

Dimensions of six skulls.

Measurements.	34730 male.	34729 female.	34728 female.	34725 male.	34726 male.	34729 ♂ jr.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Basi-cranial length (Hensel)	41.4	.....	39.4	39.1	38.0	32.0
Length of palate	25.6	24.8	24.8	24.2	23.1	19.3
Breadth across zygomata	33.4	31.7	32.4	31.1	30.0	25.9
Length of nasals	18.2	16.4	15.8	17.0	15.2	13.2
Length of upper molars (alveoli)	9.1	9.0	9.0	9.2	8.8	8.6
Length of lower molars (alveoli)	10.6	11.0	10.0	10.6	10.0	9.9
Distance from end of coronoid process to posterior point of angle	16.6	16.0	.....	16.4	15.5	13.4

The face of each of the upper and lower incisors in this species is divided in the median line by a thread-like longitudinal ridge.

19004. 34730. Male. Mount Kilima-Njaro, June 3, 1888.
18999. 34725. Male. Mount Kilima-Njaro, June 1, 1888.
19000. 34726. Male. Mount Kilima-Njaro, June 1, 1888.
19002. 34728. Female. Mount Kilima-Njaro, June 3, 1888.
19003. 34729. Female. Mount Kilima-Njaro, June 3, 1888.
19001. 34727. Male, young. Mount Kilima-Njaro, June 1, 1888.
19720. Female. Mount Kilima-Njaro, September, 1889, 5,000 feet.

Sciurus undulatus, sp. nov.

Size moderate. Tail longer than the head and body. Feet large. Thumb with narrow, convex, pointed nail. Posterior third of soles of hind feet hairy; otherwise naked. Ears small, rounded; without tufts.

General color rusty gray above; bright rust color below and on the feet. Tail with alternate bars of black and pale rusty yellow, and broadly edged with pure white. Color of male taken June 12: Fur of the back of two kinds, a fine, wavy underfur, and a long fur of straight hairs. The underfur has five rings. The basal ring is black, the next tawny, the third black, the fourth tawny, and the fifth or terminal ring black. The long fur has usually six rings, three narrow pale tawny rings, the first of which is at base of the hair, alternating with three wide black ones, the last of which is at the tip of the hair. On the head, sides of the neck, flanks, and upper portion of the legs the subterminal light ring is much paler yellow, approaching white, so that these parts are considerably lighter in color than the back.

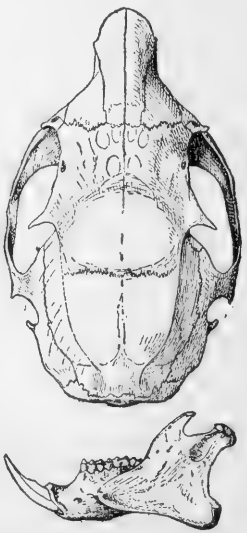


FIG. 3.—Sciurus undulatus True. Skull, natural size; U. S. Nat. Mus. No. 34731 ♂ type.

The feet are rust-colored, the hairs being black at the base.

All the under surfaces, including the inside of the legs, are bright rust-color. The hairs are gray at the extreme base, and many of them have a subterminal ring of black. Between the hind legs, however, the majority of the hairs are pale rust-color throughout. About the anus they are tipped with white.

The tail is alike on both sides and presents the appearance of alternate bars of pale yellow and black, and is bordered with pure white. The hairs have nine rings, of which four narrow ones, beginning at the base, are pale yellow. These alternate with four broader rings of black. The ninth, or terminal ring, is pure white.

The hairs at the extremity of the tail are black nearly throughout, but have two narrow rings of light yellow at the base and a terminal white ring. The latter is wanting in many instances.

The whiskers are black. The ears are clothed with short hairs of the same color as the surrounding parts. A tawny ring encircles the eye.

The female taken in September scarcely differs in any respect from the male, except that the fur is less dense.

*Measurements.**

Measurements.	♂, 19005.	♀, 19006.
	mm.	*mm.*
Length of head and body	203.0	253.0
Length of tail vertebræ	248.0	248.0
Length of tail with terminal hairs	292.0	315.0
Height of ear from the occiput	6.5	6.5
Length of fore foot and claw from the posterior tubercle	27.5	29.0
Length of hind foot and claw	52.0	47.0
Length of hairs of the tail	50.0	.....
Length of longest hairs of the back	28.0	.....

Dimensions of skull No. $\frac{34731}{19005}$ ♂.

	mm.
Greatest length	53.4
Basilar length (Hensel)	40.6
Length from posterior margin of alveolus of incisor to end of palate	21.5
Greatest zygomatic breadth	30.8
Length of upper molar series	10.8
Length of lower molar series	10.8
Depth of mandible at coronoid process	18.9
Length of nasals	15.4
Breadth of nasals at the distal extremity taken together	7.8

This skull has only the second superior premolar on one side, but on the other side there is a very slender, rudimentary first premolar. This tooth is not present in the skull of the female, and it may be considered that the species has normally but one premolar.

*As these are taken from the dry skins they are, of course, only approximately correct. The body has been somewhat elongated in No. 19006, and is crushed together in the type, so that the proper length is probably between the two measurements given.

This species appears to resemble *S. annulatus* and *S. punctatus*, as described in Dr. Jentinck's monograph of the African squirrels,* but I am unable to associate it with either.

$\frac{19005}{34731}$. Male. Mount Kilima-Njaro, June 12, 1888. 6,000 feet. (Type.)
19006. Female. Kahé, south of Mount Kilima-Njaro, September 6, 1888. (Type.)

Sciurus poensis A. Smith.

There are five specimens of a small squirrel in the collection which appear to represent this species. The greenish color of the back is not strongly marked, however, and all the under surfaces are clear fawn color, the hairs here being uniform from base to extremity. The feet are ocher-yellow. One specimen (No. 19008) is much clearer gray than the others, the ocher-yellow rings of the hairs being replaced by dull white. The long hairs at the extremity of the tail in this specimen are for the most part white, not black and ocher, as in the others. A young specimen (No. 19009) is intermediate in color between this gray individual and the normal adults.

The dimensions of four dry skins of adults are as follows:

Measurements.	19008. ♀	19719. ♀	19772. ♂	19007.
Length of head and body	165	167	169	141
Length of tail with hairs	182	191	185	187

The skulls are of the following dimensions:

Measurements.	$\frac{34733}{19008}$ ♀	$\frac{34732}{19007}$	$\frac{35244}{19719}$ ♀	$\frac{35252}{19772}$ ♂	$\frac{35234}{19009}$ jr.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*
Greatest length	39.0	39.3	40.7	39.9	37.2
Basilar length (Hensel)	30.2	29.2	.....	30.6	28.8
Zygomatic breadth	.....	22.8	22.0	22.4	.....
Length of nasals	11.2	11.0	11.6	11.4	10.2
Breadth of nasals distally	5.2	5.5	5.0	5.0	5.2
Length from post. margin of alveolus of incisor to end of palate.	15.6	14.6	.....	15.6	14.7
Length of upper molar series	7.2	7.2	.....	7.2	7.0
Length of lower molar series	7.2	7.2	.....	7.2	7.0
Depth of mandible at coronoid process	13.6	13.8	14.8	14.4	13.2

$\frac{19008}{34733}$. Female. Taveta.
$\frac{19007}{34732}$. Taveta. March, 1888.
$\frac{19009}{35234}$. Young. Taveta.
19010. Taveta.
$\frac{19719}{35244}$. Female. Mount Kilima-Njaro, November 7, 1889. 5,000 feet.
$\frac{19772}{35252}$. Male. Taveta.

Xerus rutilus Cretzschmar.

The collection contains a single female specimen of this species, from Taveta.

$\frac{19011}{35100}$. Female. Taveta.

* Notes from the Leyden Museum, IV, 1882, pp. 21 and 23.

Aulacodus swinderianus Temminck.

A single specimen (No. $\frac{19012}{34734}$) from Taveta is included in the collection.*

? Lepus capensis Linn.

The collection contains two rabbits which I assign to this species with some hesitation. They agree very closely with Wagner's description of *Lepus ochropus*,† but this species is considered synonymous with *L. capensis* by Waterhouse, Trouessart, and other authors. They agree also with Waterhouse's‡ description of *L. capensis*, except in the following particulars: The sides of the body and the lower portions of the legs and the feet are bright ocher-yellow.

The light area on the nape is of exactly the same color.

It appears probable that these specimens represent a geographical race of *L. capensis*, but as I have not material with which to compare them I am unable to decide this point.

19014. Female. Plains east of Mount Kilima-Njaro. September 20, 1888.
$\frac{19013}{34735}$. Male. Usari River, Kilima-Njaro plains. August 27, 1888

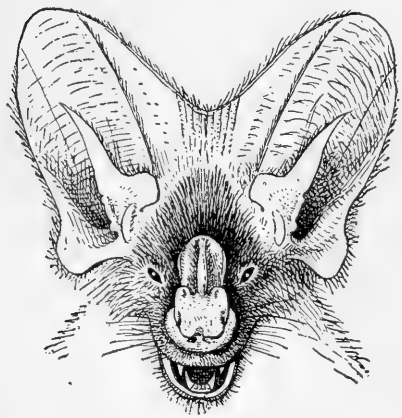


FIG. 4.—*Megaderma cor.* Head; natural size. U. S. Nat. Mus., No. 18994, ♂.

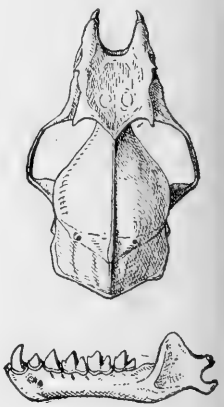


FIG. 5.—*Megaderma cor.* Skull; 1½ times natural size. U. S. Nat. Mus., No. 35276.

Megaderma cor Peters.

The collection contains two male specimens of this rare species. They agree in every particular with Peters's description. The dimensions of the body of one of these specimens are as follows:

* This skin, after being immersed in water, shows extremely brilliant iridescent colors in reflected light.

† Wagner. Schreber's Säugethiere, Supplementband, 4te Abth., 1844, p. 96.

‡ Waterhouse. Natural History of Mammalia; Vol. II, 1848, p. 95.

Megaderma cor, ♂, 18994.

	mm.
Length of head and body	71.5
Length of head	28.4
Length of ear from occiput	30.0
Length of ear from base of outer margin	39.4
Length of tragus	18.4
Length of thumb and claw	15.6
Length of second finger	48.0
Length of third finger	94.0
Length of fourth finger	73.6
Length of fifth finger	75.8
Length of tibia	32.6
Length of hind foot and claw	21.0

$\frac{18994}{35276}$. Male. Taveta. (Alcoholic.)
19755. Male. Mount Kilima-Njaro, 1889. (Alcoholic.)

Megaderma frons Geoffroy St.Hilaire.

The color of the fur in the dry skin is plumbeous, washed with dull yellow. The latter color is especially strong on the breast, head, and ears, giving the fur a soiled appearance. The minor division of the tragus is not shaped as represented in Dr. Dobson's monograph of the Chiroptera,* but is broadest opposite the point of its attachment to the major division, and has an irregularly but conspicuously serrated anterior margin. This form of the tragus is represented Geoffroy St. Hilaire's figure of the species.† A specimen from Sierra Leone, presented to the Museum by Dr. Dobson, has the linear form of minor division without conspicuous serrations. The differences in this particular may be due to age.

18992. Taveta. (Skin.)
18993. Male. Taveta. (Alcoholic.)

Nycteris thebaica Geoffroy St. Hilaire.

The collection contains four specimens of this species, as follows:

19751. Male. Mount Kilima-Njaro, 1889. (Alcoholic.)
19752. Female. Mount Kilima-Njaro, 1889. (Alcoholic.)
19753. Young. Mount Kilima-Njaro, 1889. (Alcoholic.)
19754. Female. Mount Kilima-Njaro, 1889. (Alcoholic.)

Erinaceus albiventris Wagner.

The Hedgehogs are represented by a single immature individual, 75 millimeters long, from Taveta. It appears to belong to this species. The hallux is absent. The face and feet are brown. A broad frontal band, all the under surfaces, the legs, and the tail are pure white.

$\frac{18995}{34772}$. Young. Taveta.

* Plate x, Fig. 3 † Ann. du Museum, xx, Pl. i.

Crocidura sp. ?

The collection contains several specimens of a small *Crocidura*, which I am unable to identify. In the present state of the literature, the determination of any but the commonest species in this genus is impossible without actual comparison with the types.

Connochætes taurinus albojubatus Thomas. Brindled Gnu.

Dr. Abbott collected one young individual. It is of a dull gray color, with a narrow black mane reaching to the middle of the back, where it stops abruptly and is succeeded by a dark line which reaches to the base of the tail. The mane of the neck is whitish and the tufts at the angles of the jaw entirely white. The long hairs of the tail are entirely black; the legs dirty brownish gray. No transverse dorsal stripes are visible. The backs of the ears are black.

The horns are $9\frac{1}{2}$ inches long, measured in a straight line; $12\frac{3}{4}$ inches around the longest curve. They are lyrate and straight at the points. The superior milk premolars and the first molar are in position.

$\frac{18943}{346\,8\,6}$. Young. Taveta.

Oryx callotis Thomas. Pencil-eared Oryx.

PLATE LXXVI.

Two skins which I believe to belong to this species are in the collection—that of an adult female and that of a very young individual. These I regarded at first as representing *O. beisa*, though my attention was attracted to the long pencils at the tips of the ears, which I could not find mentioned in any description of that species.

I have recently received, through the kindness of Dr. Sclater, an imperfect skin of *Oryx beisa* from Berbera, Somali, collected by Capt. Swayne. Compared with this the adult female of *O. callotis* is less tawny. The color is almost uniform, being only somewhat lighter (not white) on the belly and inside of the legs. The muzzle and the base and internal fringe of the ears, however, are soiled white. The mane begins a little behind the middle of the back (not near the tail as in *O. beisa*) and is of the same gray color as the back, though the hairs are black at the roots. There is no dark marking below the knee, but the false hoofs are surrounded by a narrow ring of black. The dark markings of the head and chest are well shown in the accompanying plate. The tip of the ear, the pencil, and the external margins half way to the base, are black.

The young specimen resembles the figure of a young *O. beisa* published by Dr. Sclater,* but is a little paler in color.

The horns of the adult are $29\frac{3}{4}$ inches long, and $8\frac{1}{4}$ inches apart at the tips. Those of the young individual are but $3\frac{1}{4}$ inches long. The skull of this specimen has only the three milk premolars in position in the upper jaw.

$\frac{18944}{346\,8\,7}$. Adult female. Taveta.
$\frac{18945}{346\,8\,8}$. Young. Taveta.

* Proc. Zoöl. Soc. London, 1881, pl. 54.

Alcelaphus cokii Gunther. Coke's Hartebeest.

Four skins of this singular antelope were preserved. They are entirely of a dull tawny brown color. The tail is crested; pale brown in the proximal third and black distally, with some brown hairs intermingled. The ears are brown without, white within.

The horns of the female are smaller than those of the male, and differ in having the points directed backward exactly in the plane of the forehead, and slightly approximated. In the male the extremities of the horns are directed downward as well as backward and are parallel or slightly divergent.

The horns of four individuals are of the following dimensions:

Measurements.	34689 ♂ ad.	34690 ♂ ad.	34691 ♂ jv.	34692 ♀ ad.
	Inches.	*Inches.*	*Inches.*	*Inches.*
Length in a straight line	$10\frac{3}{4}$	$11\frac{1}{2}$	$10\frac{3}{4}$	$9\frac{1}{4}$
Length around the curves in front	$14\frac{3}{2}$	$16\frac{1}{8}$	$13\frac{3}{4}$	12
Distance between the extremities	14	$12\frac{3}{4}$	17	$10\frac{3}{4}$

All have the permanent dentition, except the young male (34691), which has the superior milk premolars and the three molars.

$\frac{18946}{34689}$. Taveta. (Skin and skull.)
34690. Taveta. (Skull.)
34691. Taveta. (Skull.)
34692. Taveta. (Skull.)
18947. Taveta. (Skin.)
18948. Taveta. (Skin.)
19706. Mount Kilima-Njaro, 1889.

Kobus ellipsiprymnus (Ogilby). Water buck.

Three males—an adult, a half-grown and a young individual—make up the series of this species. The largest male has horns $19\frac{1}{2}$ inches long in a straight line, $22\frac{3}{4}$ inches around the posterior curve, and the tips are 8 inches apart. This individual has the entire permanent dentition, with the last molar unworn. The second male has horns 10 inches long, measured in a straight line; 11 inches, if measured around the posterior curve. The tips are $8\frac{3}{4}$ inches apart. In this case the last true molar has not appeared, and the premolars are those of the milk-dentition. The third specimen has only the milk premolars in position.

The youngish male is more dusky throughout than the adult.

$\frac{18949}{34693}$. Male, adult. Taveta.
$\frac{18950}{34694}$. Male, young. Taveta.
$\frac{18951}{34695}$. Male, very young. Taveta.

Tragelaphus scriptus roualeynii (Gordon-Cumming). Bosch-bok.

Skins of a male and a female of this subspecies, according to Mr. Thomas's revision of the genus, were preserved. The male is much darker than the female. No transverse white lateral bands are visible

and the spots are about 25 in number on each side, irregularly placed.

The horns of the male are $11\frac{1}{2}$ inches long, measured in a straight line, and have the tips $4\frac{3}{4}$ inches apart.

$\frac{18952}{34696}$. Male, adult. Taveta.
$\frac{18953}{34697}$. Female, adult. Taveta

Æpyceros melampus (Lichtenstein). Pallah Antelope.

Five skins and five skulls of this graceful antelope, together with skins of two heads, are included in the collection. The upper third of the backs of the ears is black in all these specimens, a disposition of color which I have not noted in the figures that I have examined. The mammæ are four in number—not two, as stated by Harris and Gray.

In the largest male the horns are 18 inches (457 millimeters) long in a straight line, and the tips are $10\frac{1}{4}$ inches (260 millimeters) apart; in a smaller male they are $15\frac{1}{2}$ inches (394 millimeters) long, with tips 7 inches (178 millimeters) apart. Both are thoroughly adult animals.

$\frac{18955}{34699}$. Male. Taveta. (Skin and skull.)
$\frac{18954}{34698}$. Female. Taveta. (Skin and skull.)
18957. Male. Taveta. (Skin.)
18956. (?) Taveta. (Skin.)
19707. (?) Mount Kilima-Njaro, 1889.
$\frac{19709}{35239}$. (?) Mount Kilima-Njaro, 1889. (Skin of head.)
$\frac{19710}{35240}$. (?) Mount Kilima-Njaro, 1889. (Skin of head.)
34777. Male. Taveta. (Skull.)

? **Eleotragus arundinaceus** Gray. Reedbuck.

Dr. Abbott collected two young male antelopes belonging to this genus, but whether they represent this or some other species I am unable to determine. An examination and comparison of the various nominal species would be necessary before a decision could be reached.

The general color of the back (in No. 18958) is ocher-yellow. The hairs are pale chocolate-brown at the base, with a subterminal ring of ocher-yellow and short, black tip. On the sides, the base of the hairs is paler and the black tips are less conspicuous. The upper surface of the tail and the legs externally are like the back. The front of the fore legs is dusky, owing to an increased amount of black at the extremity of the hairs. The face is like the back, but somewhat darker in the median line and paler on the cheeks. There is a white spot in front of the eye, and the hair between the eye and ear is short and of a yellowish-white color. There is a naked spot beneath the ear. The ears are white within, ocher-yellow without. The chin and throat, the inside of the legs, and the belly are white.

The naked muffle scarcely extends backward to a line joining the posterior angle of the nostrils.

The greatest length of the skull in this individual is 9 inches. The horns measured around the curve, posteriorly, 7.25 inches. The ears

are 5.4 inches long, and the tail, with the hairs, 8.5 inches. The first and second permanent premolars and the third milk premolar are in position in the upper jaw.

18958/34700. Male, young. Taveta.
18959/34701. Male, young. Taveta.

Gazella grantii. Grant's Gazelle.

This fine antelope is represented by the skins of three adult females and two adult males, together with the skin of the head of a male. The horns are as follows:

Measurements.	18960 34702 ♂	18961 34703 ♂	18962 34704 ♀	18963 34705 ♀
	Inches.	*Inches.*	*Inches.*	*Inches.*
Length of horns in straight line	19½	19½	12	13¾
Length of horns around the curves	21¼	20¼	12¼	14
Distance between tips	10⅜	8½	5	5¾

18960/34702. Male, adult. Taveta.
18961/34703. Male, adult. Taveta.
18962/34704. Female, adult. Taveta.
18963/34705. Female, adult. Taveta.
19705/35237. Female. Mount Kilima-Njaro, 1889. (?)
19708/35238. Male. Mount Kilima-Njaro, 1889. (Skin of head.)

Gazella thomsonii Günther. Thomson's Gazelle.

Plate LXXVII.

A single adult male of this small but handsome species is in the collection. As the species is imperfectly known, a description of the skin may not be without value.

Back bright tawny brown. Sides abruptly paler. A broad black lateral band. Belly pure white. Face brown, with a broad white band on each side of the median line, which extends back to and encircles the eye. Front of upper lip and all the under parts pure white. Legs brown externally, white within. The tail is hairy and is dusky throughout, with some brown hairs intermingled. The ears are pale brown without and white within. The knees are conspicuously tufted.

The horns are 12½ inches long, measured in a straight line, and the tips are 4 inches apart.

18964/34706. Male, adult. Taveta.

Cephalophus spadix True. Abbott's Antelope.

Plates LXXVIII and LXXIX.

This singular antelope is the central figure in Dr. Abbott's extensive collection. He obtained the unique type specimen high up in Mount Kilima-Njaro. No other specimens have been obtained before or since, unless the species described by Gray under the name of *Cephalophus*

niger is to be regarded as identical. To this question I shall refer again presently. I have already described Abbott's antelope in an earlier part of this journal,* but, for convenience of reference, will repeat the description in this place:

(Adult male, No. 18965.)—Size large. Naked rhinarium broadly triangular, rugose, completely encircling the nostrils. The portion external to the nostrils is broadest at their inferior external angle.

A narrow band bordering the lip is sparsely covered with hairs, which are not sufficiently numerous to conceal the rugose integument.

Ears moderate, broad, obtuse; naked within, except on the margin and along two or three narrow lines. Hoofs of the fore and hind feet equal. Each moiety less than twice as long as broad at the base. False hoofs moderate, slightly less than one-third as long as the true hoofs.

Tail short, well haired on both sides, except a small triangular area at the base, which is naked.

Hair short, dense, appressed, and shining.

Color throughout dusky chestnut-brown, without spots or bands, and not lighter on the belly. Face, chin, and throat pale grayish brown. Hairs of the frontal crest bright chestnut at the base and tipped with black. Mingled with them are some hairs which are dusky throughout and others pure white. Anterior surfaces of the legs somewhat lighter than the posterior surfaces. A few white hairs above the hoofs and also on the rump. Tail dusky, except at the tip, where the hairs are nearly pure white throughout.

Skull elongate. Muzzle slender. Premaxillæ directed backward, touching the nasals by their superior rather than their posterior margin. Nasals very long, much produced anteriorly. Frontal region strongly convex. Suborbital pit nearly circular, as large as the orbit.

Horns 4½ inches (114.3 millimeters) long; slender, straight, not thickened at the base in front. They are directed backward and lie below the plane of the upper surface of the skull.

Lower incisors separated by a wide space in the median line. Crowns long, inclined outward. Outer incisor more than half as broad as the middle incisor.

HABITAT: High altitudes on Mount Kilima-Njaro, frequenting the highest points.—(Abbott.)

DIMENSIONS.†

	Inches.	mm.
Head and body	38	965.2
Tail, with hairs	4½	114.3
Fore leg, hoof to knee	6¼	158.7
Hind leg, hoof to hock	9½	241.3
Height of ear from occiput	4¼	107.9

* Proc. U. S. Nat. Mus., XIII, 1890, p. 227.

† From the dry skin.

Skull

	mm.
Greatest length	235.0
Basilar length, from occipital condyle to end of intermaxillæ	216.0
Length of nasals	95.0
Length of molar teeth	67.0
Greatest breadth of skull	104.0
Length of orbit	40.0
Greatest length of mandible	184.0
Breadth of left lower incisors and canine	13.0
Length of horns	114.3
Circumference of horn at base	75.0

The specimen has been mounted since this description was first published, and is in a much better condition for study than it then was. I find no necessity, however, to materially alter the description. The hairs of the frontal crest should be described as chestnut red, rather than bright chestnut. The forehead is dusky brown, like the body, rather than pale grey brown, like the face.

The mounted skin was examined by Dr. Abbott while it was in the taxidermist's shop, and several corrections of the shape were made at his suggestion. He pronounced it when finished as conveying a good idea of the species in life.

The only species to which Abbott's antelope appears to be closely related is, as already stated, the *Cephalophus niger* of Gray. This was originally described in the Annals and Magazine of Natural History (18, 1846, pp. 165, 166). The description is as follows:

Black Bush Buck, Cephalophus niger. Antelope niger, Mus. Leyden.

Sooty black, grayer in the front half of the body; chin, throat, abdomen, and inside of thighs, gray; forehead, crown dark bay and black mixed; cheeks pale brown and black varied; tail end whitish.

Inhab. Guinea.

In the British Museum there is a male from the Leyden Museum nearly as large as the former. There is at Knowsley, a bush buck which is now shiny black with a reddish brown crest; when young it was red on the sides; it is perhaps the same as the above.*

In a general way this description is applicable to our specimen, but the latter cannot be called black: it is a dark brown. The abdomen and inside of thighs are also dark brown, not gray, as stated in Gray's description.

There is a spirited drawing of Gray's *C. niger* in the "Gleanings from the Knowsley Menagerie." It probably represents the individual mentioned in the second paragraph of the description quoted above. There is much more light color on the posterior part of the fore leg

*In the proceedings of the Zoölogical Society of London for 1871 (p. 598), the description is varied, as follows: "Hair of cheeks and neck very short, sooty black."

than in Abbott's antelope. The tail is represented as slender, with a large white tuft at the end, and apparently as being white underneath. In Abbott's antelope the tail is equally broad throughout and is dark brown on both sides, with only a few white hairs at the tip.

Considering the common inaccuracy of descriptions, it is possible, I presume, that the two species may be identical, but until a detailed description of *C. niger*, with measurements of the exterior and skulls, has been published, the question must remain open.

$\frac{18965}{34707}$. Male, adult. Mount Kilima-Njaro. Type.

Cephalophus nigrifrons Gray. Black-fronted antelope.

The collection contains a single male from Taveta. Gray's figure* of the species is in some respects inadequate, and in others does not agree exactly with the specimen under consideration. The size is not indicated. Compared with the figure, our specimen has shorter and thicker compressed horns. The horns are stout at the base and diminish abruptly from about the middle toward the tip. The muzzle is entirely dusky brown, not rufous, with a median dark band, as represented in the figure. The broad black frontal band continues with undiminished breadth to the base of the horns, and the slight crest between the horns, as well as the median line of the nape, are black. The fore legs, within and without, are entirely dusky, not rufous above the knee, as represented in the figure.

The specimen, as mounted, gives the following dimensions:

Dimensions of body.

	mm.
Length from tip of nose to base of tail (along the curves)	856.0
Length of head	197.0
Length of tail, with hairs	127.0
Height at shoulder	442.0
Length of ears (from behind)	65.0
Length of horns	85.0
Girth of horns at base	70.0

Skull.

	mm.
Greatest length	182.0
Basi-cranial length, from tip of premaxillæ to front of foramen magnum	160.0
Length of palate	95.0
Length of nasals	57.0
Breadth between orbits	50.0
Depth (vertical) of orbits	31.0
Length of orbits	32.0
Length of superior molars	50.0
Length of horn-cores (from behind)	56.0

$\frac{18966}{34708}$. Male adult. Taveta.

* Proc. Zoöl. Soc., London, 1871, pl. 46.

Neotragus damarensis Günther. Damara-land Pygmy Antelope.

Plate LXXX.

This beautiful little antelope is represented by four specimens, two males and two females. Dr. Günther's description of the species is very brief, but the most important statement is that it is almost identical in external appearance with *N. saltiana*, which is the case with these specimens*. The older male and female have a strong tinge of rusty yellow on the back, which is less apparent in the younger specimens. In one of the adult females the rust-red hairs of the crest are tipped with black, but in the others this does not occur. The rump is clear gray. The tail is extremely short and is of the same color as the adjacent parts.

An examination of the skulls of the two males indicates that *N. Kirkii*, described by Dr. Gunther with *N. damarensis*, may be the young of the latter. The comparisons of cranial characters are unfortunately made between *N. Kirkii* and *N. saltianus*, which are much less closely allied than *N. Kirkii* and *N. damarensis*.

Of the five characters brought forward the first, second, and fifth are common to *N. Kirkii* and *N. damarensis*. The third relates to the shape and size of the nasal bones. In *N. Kirkii*, "their posterior margins form an almost straight transverse line," while in *N. damarensis* they form an acute angle as in *N. saltianus*. I find that in our younger skull the posterior angle is very obtuse, approximating, therefore, to the condition of *N. Kirkii*, while in the older skull the angle is very acute, as much so as represented in Dr. Günther's figure of *N. saltianus*. In this older skull the nasals extend backward to the line of the anterior margin of the orbits, while the younger skull represents an intermediate condition between this and that of *N. Kirkii*.

It would appear that the size and shape of the nasals are not to be relied upon, since they are so largely affected by age.

One character only remains. The angle of the mandible is represented as very prominent in *N. Kirkii*. It is much more so than in either of our skulls, which should not be the case if the skull figured by Dr. Günther were merely a younger individual of the same species as our specimens. It is possible that this character is of some value in distinguishing *N. Kirkii* from *N. damarensis*.

An examination of the subjoined measurements of the skulls will bring out the differences in the size and position of nasal bones and other characters dependent upon age:

* A skin of *N. saltiana* from Somali, which Dr. Sclater has recently sent to the Museum, confirms this fact. The only differences which I can detect are that in *N. saltiana* the cheeks and back of the neck are clear gray instead of tawny, while the tawny color of the flanks is darker and stronger than in *N. damarensis*.

Dimensions.

Measurements.	34709 ♂.	34780 ♂.
	mm.	*mm.*
Greatest length	105.0	110.6
Basicranial length from end of premaxillæ to front of foramen magnum	91.0	97.0
Extremity of premaxillæ to first premolar	22.6	25.7
Extremity to end of palate in median line	51.0	57.0
Length of nasals in median line	20.3	24.2
Greatest breadth of nasals	19.0	20.0
Posterior extremity of nasals to fronto-parietal suture	32.2	33.0
Breadth of premaxillæ at the extremity	7.5	7.7
Length of orbit	25.5	25.6
Depth of orbit (vertical)	22.0	23.0
Length of molar series	36.5	37.5
Length of coronoid process of mandible from base of posterior margin	18.5	17.6
Length of horn cores	46.0	.....
Length of horns	64.5	60.5
Greatest diameter of horns at base	14.6	15.0

$\frac{18967}{34709}$. Male. Taveta.
18968. Male. Taveta.
18969. Female. Taveta.
18970. Female. Taveta.

Nanotragus moschatus (Sundevall). Zanzibar Pygmy Antelope,

The collection includes the skin of a young male antelope of very small size, which may be this species. It agrees well with Sundevall's description. The length of the flat skin (head and body) is 20 inches. The individual is quite young, as is indicated by the entire absence of horns and by the condition of the teeth. Only four molars and premolars are in position in each side the mouth, above and below; the premolars belong to the milk dentition. Dr. Abbott remarks on the label: "Brought alive by natives, who say that the *adult* male is a little larger and has small horns." The native Kichaga name of the species is *Suni*.

$\frac{19734}{38249}$. Male, young. Mount Kilima-Njaro, December 9, 1889, about 6,000 feet.

Bubalis caffer (Sparrm.). Cape Buffalo.

The heads of two males and two females of this species were brought home by Dr. Abbott. The larger male is a remarkably fine specimen, with very large horns.

The dimensions of the skulls and horns are as follows:

Measurements.	34710, ♂.	34711, ♂.	34712, ♀.	34713, ♀.
	cm.	*cm.*	*cm.*	*cm.*
Basilar length of skull, from surface of occipital condyle to end of premaxillæ	*48.0	50.0	45.2	49.5
Length of horn around the outer curve	63.5	61.5	63.5	62.5
Greatest breadth of horn at the base	23.0	21.0	11.5	10.5
Least distance between bases of horns	3.5	3.5	16.0	18.0
Distance between tips of horns	62.5	63.0	33.5	47.0

* The condyles are wanting; about 3 centimeters should be added to the length.

$\frac{18971}{34710}$. Male, adult. Taveta. (Skull and skin of head.)
$\frac{16972}{34711}$. Male, adult. Taveta. (Skull and skin of head.)
$\frac{18973}{34712}$. Female, adult. Taveta. (Skull and skin of head.)
$\frac{18974}{34713}$. Female, adult. Taveta. (Skull and skin of head.)

Potamochœrus africanus (Schreber).

A single river-hog is included among the skins. It is from Mount Kilima-Njaro.

19704. Mount Kilima-Njaro, 1889 (?).

Phacochœrus ælianii (Rüppell).

Dr. Abbott collected three wart-hogs at Taveta, one of which is a fine male with very large tusks.

18975. Taveta.
18979. Taveta.
18980. Taveta.

Rhinoceros bicornis (Linné).

The two-horned rhinoceros is represented by four heads from Taveta in different stages of growth.

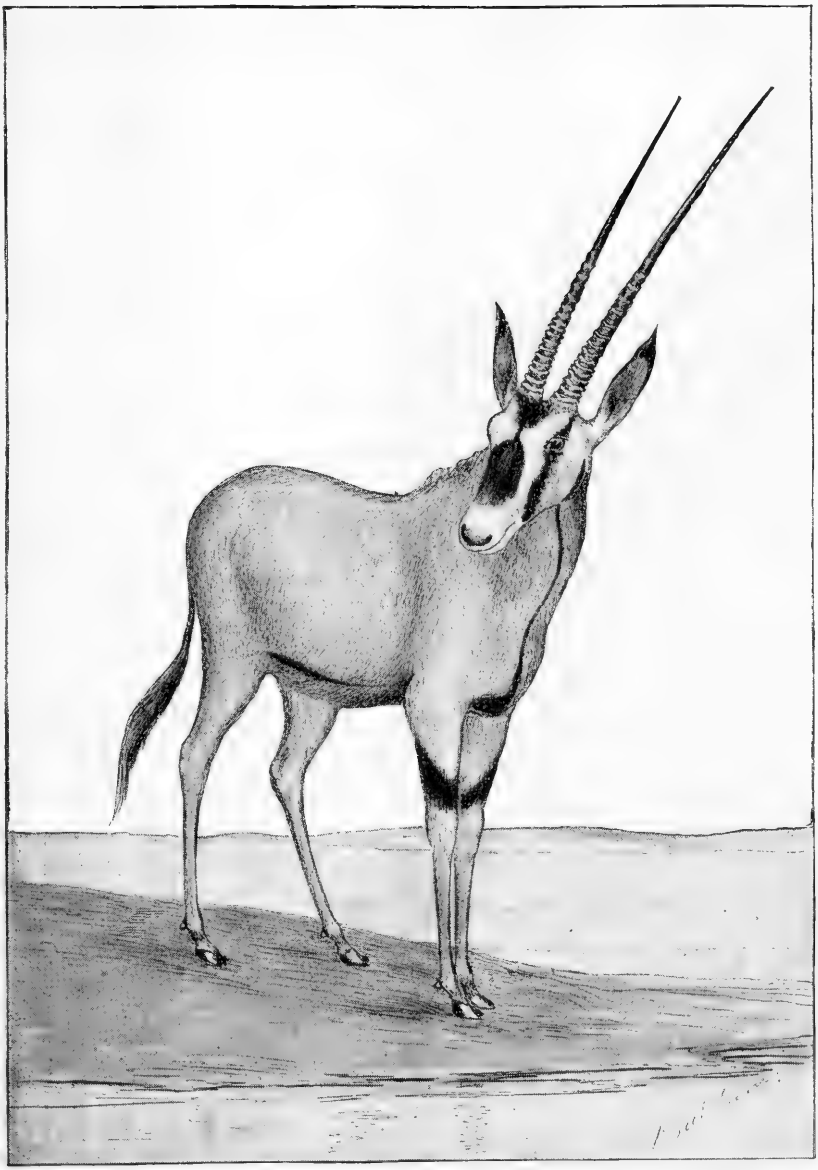
18981. Fœtal. Taveta.
18982. Young. Taveta.
18985. Female, young. Taveta.
18983. Female. Taveta.
18984. Female. Taveta.

The following list comprises all the species included in Dr. Abbott's collection:

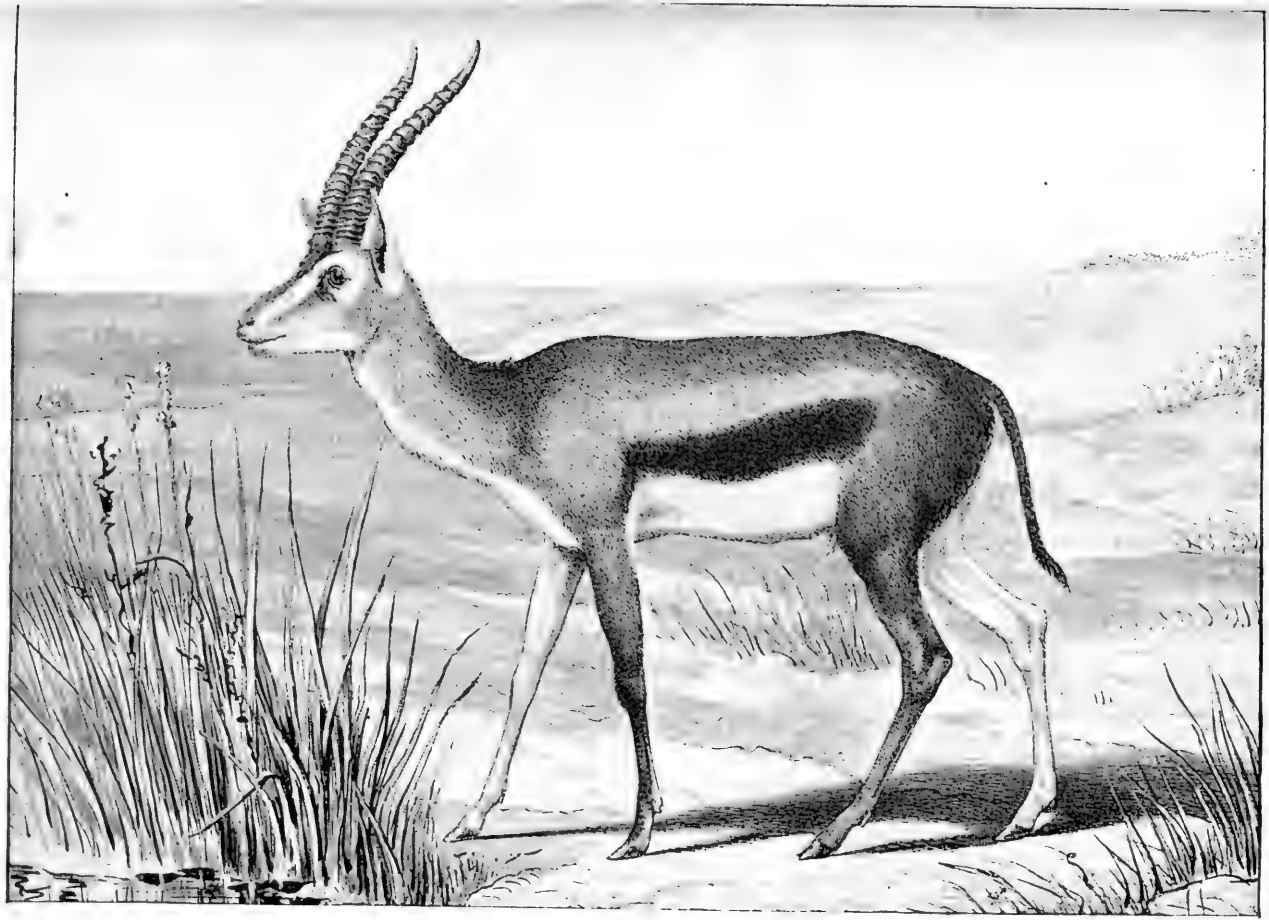
Colobus caudatus. Kahé.
Cercopithecus albogularis. Taveta.
Cercopithecus sabæus. Taveta.
Galago crassicaudatus. Taveta; Arusha Wacini.
Helogale undulata. Plains east of Mount Kilima-Njaro; Taveta.
Herpestes gracilis. Plains east of Mount Kilima-Njaro.
Herpestes caffer. Mount Kilima-Njaro, 5,000 feet.
Herpestes galera robustus. Mount Kilima-Njaro, 4,000 and 5,000 feet.
Crossarchus mungo. Taveta.
Genetta pardina. Taveta; Mount Kilima-Njaro, 6,000 feet.
Mellivora capensis. Mount Kilima-Njaro, 5,000 feet.
Canis mesomelas. Taveta.
Otocyon megalotis. Arusha Wacini, 2,500 feet; Taveta.
Dendrohyrax validus. Mount Kilima-Njaro, 5,000–6,000 feet; Taveta.
Procavia brucei. Foot of Kyalu mountains, near Mount Kilima-Njaro.
Eliomys murinus. Mount Kilima-Njaro, 5,000 feet.
Mus arborarius. Mount Kilima-Njaro, 4,000–5,000 feet.
Mus barbarus. Mount Kilima-Njaro, 5,000 feet; Taveta.
Mus aquilus. Mount Kilima-Njaro, 8,000 feet (killed by a hawk).
Mus? minimus. Mount Kilima-Njaro.
Mus sp.? Mount Kilima-Njaro, 5,000 feet.
Dendromys nigrifrons. Mount Kilima-Njaro, 5,000 feet; Taveta.
Otomys irroratus. Mount Kilima-Njaro, 4,000–5,000 feet.
Rhizomys splendens. Mount Kilima-Njaro, 5,000 feet.
Sciurus undulatus. Mount Kilima-Njaro, 6,000 feet; Kahé.
Sciurus poensis. Mount Kilima-Njaro, 5,000 feet; Taveta.
Xerus rutilus. Taveta.
Aulacodus swinderianus. Taveta.

Lepus? capensis. Plains east of Mount Kilima-Njaro; Usari River.
Megaderma frons. Taveta.
Megaderma cor. Taveta.
Nycteris thebaica. Mount Kilima-Njaro.
Erinaceus albiventris. Taveta.
Crocidura sp.
Connochætes taurinus albojubatus. Taveta.
Oryx callotis. Taveta.
Alcelaphus cokii. Taveta.
Kobus ellipsiprymnus. Taveta.
Tragelaphus scriptus roualeynii. Taveta.
Æpyceros melampus. Taveta.
Eleotragus? arundinaceus. Taveta.
Gazella grantii. Taveta.
Gazella thomsonii. Taveta.
Cephalophus spadix. Mount Kilima-Njaro; high altitudes, 8,000 feet.
Cephalophus nigrifrons. Taveta.
Neotragus damarensis. Taveta.
Nanotragus moschatus. Mount Kilima-Njaro, about 6,000 feet.
Bubalus caffer. Taveta.
Potamochærus africanus. Mount Kilima-Njaro.
Phacochærus ælianii. Taveta.
Rhinoceros bicornis. Taveta.

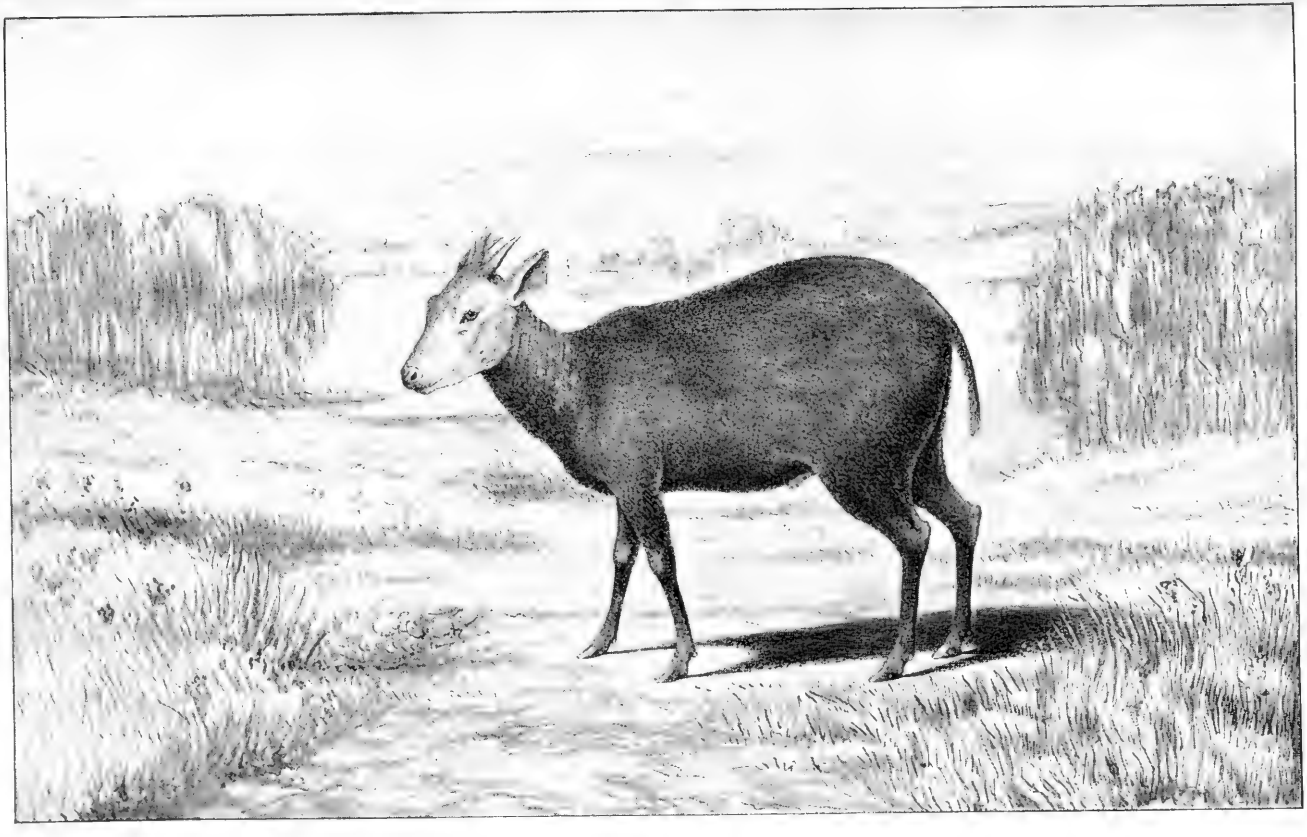
TREE DAMAN, *Dendrohyrax validus* True.
Skull; a little larger than life. U. S. National Museum, No. 34972.



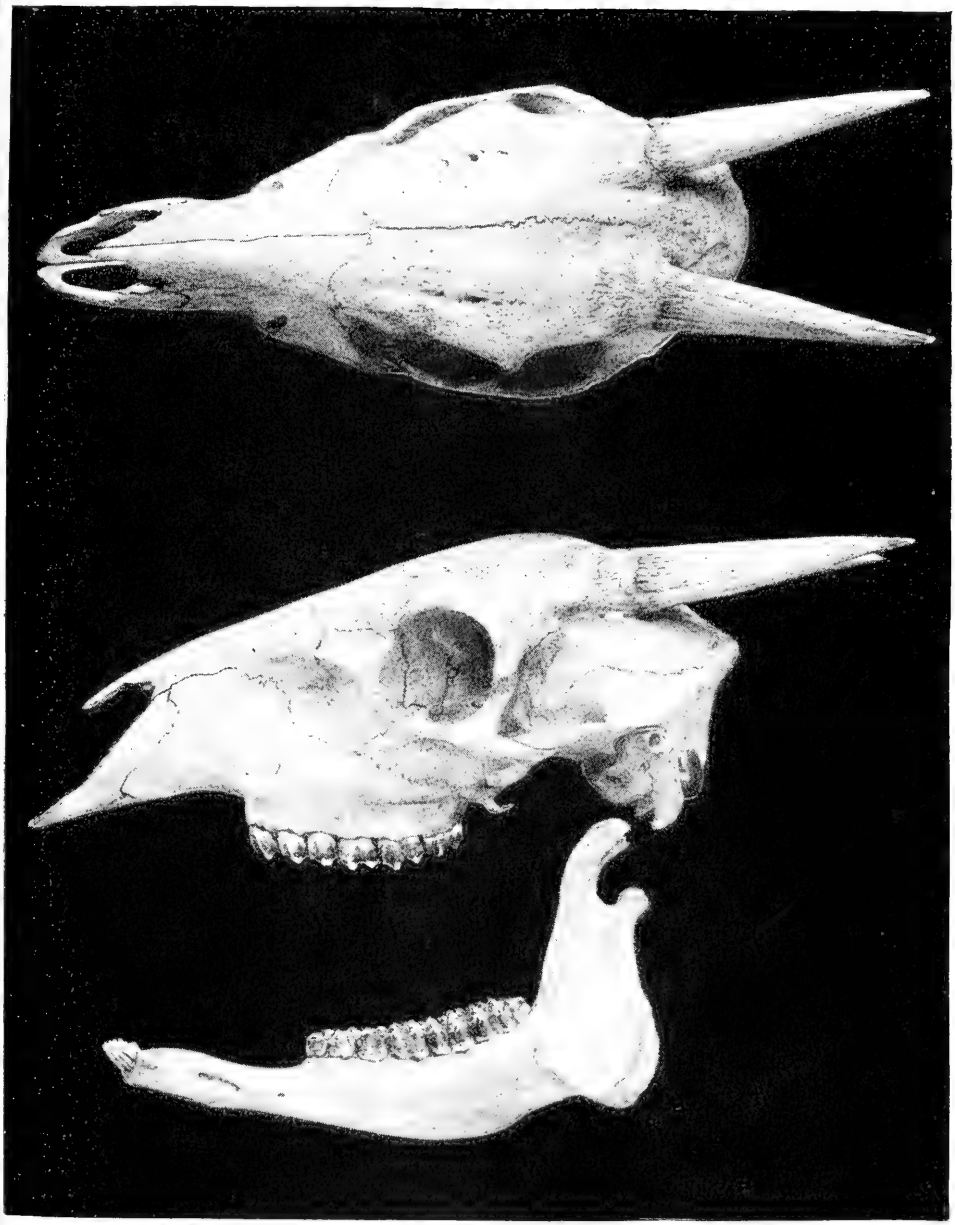
PENCIL-EARED ORYX, *Oryx callotis* Thomas.
U. S. National Museum, No. 18944.



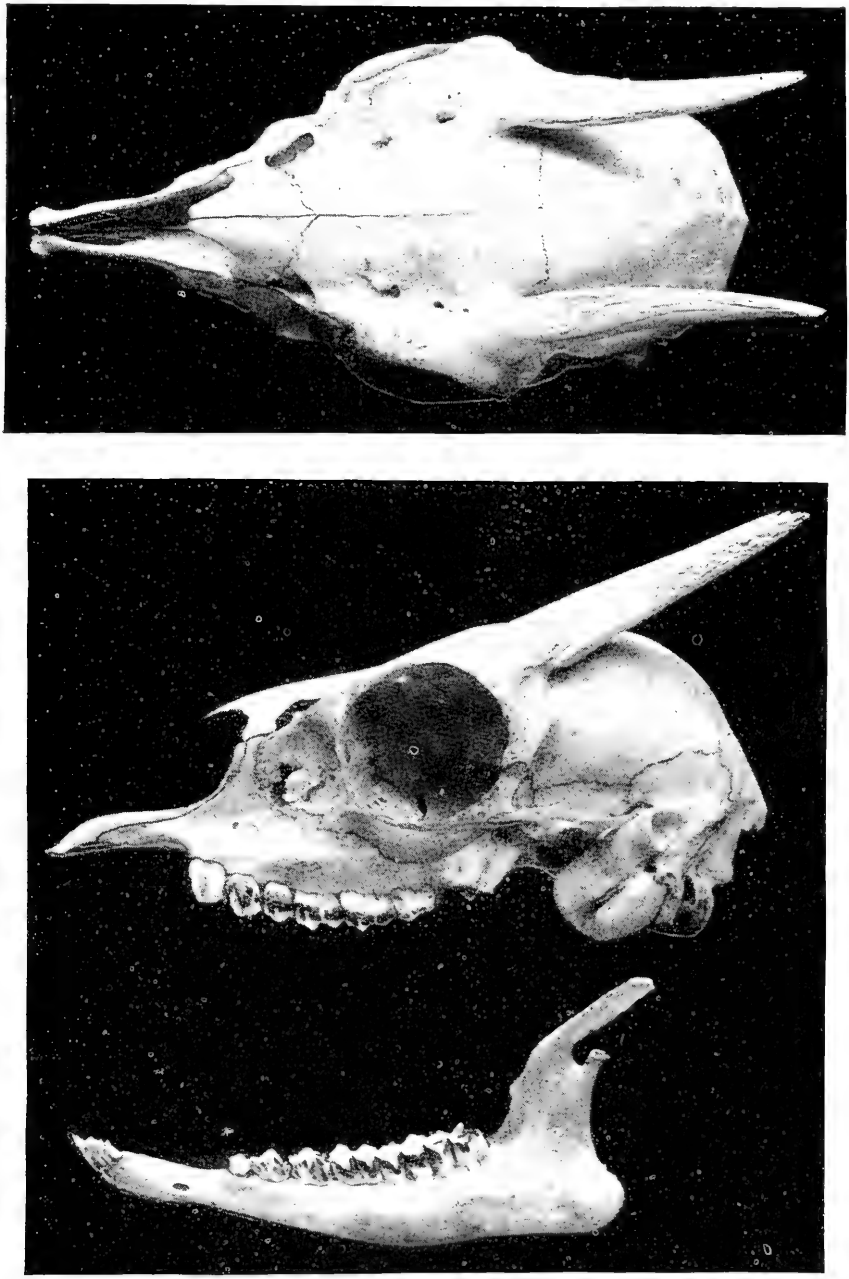
THOMSON'S GAZELLE, *Gazella thomsonii* Günther.
U. S. National Museum, No. 18964.



ABBOTT'S ANTELOPE, *Cephalophus spadix* True.
U. S. National Museum, No. 18965. Male. Type.



ABBOTT'S ANTELOPE, *Cephalophus spadix* True.
Skull; a little less than one-half natural size. U. S. National Museum, No. 34707. Type.



DAMARA-LAND PYGMY ANTELOPE, *Neotragus damarensis* Günther.
Skull; slightly smaller than natural size. U. S. National Museum, No. 34709. Male.

A DESCRIPTION OF THE GOLDEN TROUT OF KERN RIVER, CALIFORNIA, SALMO MYKISS AGUA-BONITA.

By David Starr Jordan.

I have lately received from Mr. W. H. Shockley, of San Francisco, three specimens, each about 7 inches in length, of the Golden Trout of Kern River. These specimens were taken by Mr. Harvey, of Lone Pine, Cal., in a stream called by him Whitney Creek (more correctly Volcano Creek), on the west side of the Sierra Nevada, near Mount Whitney. The specimens were sent in ice to Mr. George T. Mills, fish commissioner of the State of Nevada, who forwarded them to Mr. Shockley. The following is a detailed description:

Salmo mykiss agua-bonita, new subspecies.

Head, $3\frac{3}{4}$ in length; depth, $4\frac{1}{3}$. D. 2, 12. A. 1, 10. Scales, 180 to 200 rows; 121 to 124 pores. Length, 7 inches.

Body formed about the same as usual in *Salmo mykiss* and its varieties. Head rather long, bluntish at tip; mouth moderate, the maxillary extending a little beyond the eye, $1\frac{4}{5}$ in head; hyoid teeth not evident; opercle moderate, its greatest length $4\frac{1}{3}$ in head, its posterior margin moderately convex; eye, $4\frac{2}{3}$ in head; snout, $4\frac{1}{2}$; gill rakers not very short, X + 11 or 12 in number.

Scales extremely small, smaller than in any other species of *Salmo*. Fins moderate; the anal high; the caudal moderately emarginate. Pectoral, $1\frac{4}{7}$ in head; ventral, 2; caudal, $1\frac{2}{5}$.

Olive above; sides and belly light golden. About twelve dark crossbars on middle of sides; these the usual parr-marks. Middle of sides along lateral line with a deep scarlet lateral stripe, broadest under the dorsal, where it is about as wide as the eye; thence narrowing to either end and not reaching either head or caudal. Middle line of belly with a broad scarlet band, extending from chin to anal fin, equally bright all the way; a fainter shade along lower side from anal fin to tip of caudal. No crimson dash at throat between branches of lower jaw; the whole region uniform bright orange. Opercle largely orange.

Dark spots chiefly posterior as in *S. spilurus* and *pleuriticus;* large and well marked, some on tail and posterior part of body as large as pupil; smaller and well marked on dorsal; a few small ones scattered along forward to the head in two specimens; none on body before adipose fin in the other.

Upper anterior angle of dorsal abruptly yellowish white; this color edged by a dark oblique streak, made by coalescent spots; the rest of

the fin light olive with four or five rows of small black spots; pectorals light orange; ventrals deep orange, with a faint blackish tip; the anterior edge of the fin conspicuously and abruptly whitish, as in *Salvelinus fontinalis*. Anal dusky orange, the tips of the last rays blackish, the outer anterior corner abruptly white, the white stripe wider than the pupil and separated from the color of the fin by a dusky shade.

Caudal olive, tinged with orange on its lower edge, and profusely spotted with black. Inside of mouth pink; of gill cavity, light orange.

Of the three typical specimens two have been sent to the U. S. National Museum and one remains in the museum of the Leland Stanford Junior University.

This trout is evidently an off-shoot or descendant of the widely distributed Cut-Throat Trout, *Salmo mykiss*, which is found in all the rivers suitable for trout between the Sierra Nevada and the Rocky Mountains. It differs, however, from any known specimens of any of the many varieties of *Salmo mykiss* in its pattern of coloration and the absence of the deep red patch between the branches of the lower jaw, from which *Salmo mykiss* receives its common name—the Cut-Throat Trout—and in the small size of its scales, which are more numerous than in any of the forms of *Salmo mykiss*. Matters of less importance, which are, however, comparatively distinct, are the presence of white and black edges to the fins, and in the absence of teeth on the hyoid bone. The name *agua-bonita*, suggested for the species, is that of Agua Bonita Falls, the cataract in Volcano Creek, near which these specimens were found.

The earliest record of this trout is that of Jordan and Henshaw in Appendix NN of the Annual Report of the Chief of Engineers for 1878, p. 199. The specimen collected by Mr. H. W. Henshaw, in 1875, from the south fork of the Kern River, and No. 17107 in the National Museum collection, are referred to *Salmo pleuriticus* Cope. With this reference is the remark that "the extension of its range west of the Sierra Nevada is rather unexpected. The prevalent theory that most of the species of trout have a narrow local range is hardly supported by a study of our western forms." This trout, Mr. Henshaw says, was "abundant in the South Fork of the Kern River, beyond which statement nothing can be said of its distribution on the western coast, or of its abundance as compared with *S. irideus*, the distinctness of the forms not having been recognized at the time of the collection."

On page 195 of the same paper is a reference by Mr. Henshaw to the "Golden Trout" which apparently belongs to the species here described, although Mr. Henshaw identifies his specimens taken from near Mount Whitney with the *Salmo irideus*. Mr. Henshaw says:

> This is the common "Brook Trout" of the small mountain streams of the Pacific slope, and up to an altitude of 9,000 feet it is the rare exception to find a suitable stream that is not well stocked with it. Upon many of them, as the tributaries of the South Fork of the Kern River, these trout are found in very great abundance, each pool and rapid numbering its finny denizens by the score. They may be taken in any sort of weather, at any hour of the day, by almost any kind of bait. During

the heat of the day they frequent almost entirely the deeper pools, lying under overshadowing rocks or in the shade of some convenient log. In early morning or late afternoon they come out and run more into the shallows and rapids, under which circumstances they bite best and furnish the finest sport. Like the average brook trout, the species rarely attains any considerable size, ranging from 4 to 8 or more inches in length. Their colors are usually very bright, and for beauty this species takes rank among the foremost of its kind, and has been well called the "Golden Trout." In this respect, however, it is subject to the usual variations obtaining in the family, the change of color not only accompanying a difference in locality, but being plainly discernible in individuals taken in different parts of the same stream not far distant. In fact, as a specific character, color in this family seems to be at its lowest value. The character of the bottom and water itself has much to do with this, and I remember to have fished in a small rivulet on one of the subalpine meadows not far from Mount Whitney, whose sluggish waters flowed over a bottom of dark mud, in which the color of the trout simulated very closely its hue; they had lost nearly all the flashing iridescent tints characterizing the same species caught but a few hours before in another stream, and had become dull and somber hued. Accompanying this change of color was a correspondingly noticeable difference in habits and motions, and the several dozen trout caught that evening for supper were taken out with the hook with the display of very little more gameness than would be noticed in so many Horned Pout. On the contrary, in the clear rapid current of the mountain stream, a flash of sunlight is scarcely quicker than the gleam of gold and silver seen for a single instant as the whirling waters are cut by one of these trout as he makes a rush from his lurking place for some chance morsel which is being borne past him. The western trout are rarely as shy as their relatives of eastern waters, and because of their numbers and the consequent scarcity of food are apt to be less fastidious; yet, even when most abundant, due caution must be used if one would be successful, and not every one can catch trout, even in the West. With the proper care in concealing one's self, a pool may be almost decimated ere the alarm will be taken, and I have seen fifteen fair-sized trout taken from a single small pool in quick succession.

During the present year other specimens have been sent to the museum of the Leland Stanford Junior University, but in such very bad condition that nothing could be made of them, except that they were evidently small-scaled trout of the *mykiss* type, nearest to the subspecies *pleuriticus* of the Colorado River, and not in any way related to the Rainbow trout, which inhabits most of the streams of the basin of California.

The question of the relation of this trout to others in Kern River must be settled by further investigations, as also the question whether the *Salmo agua-bonita* itself is confined, as has been asserted, to the space in Volcano Creek between the two waterfalls, or whether in that part of the stream is found a variety different from the ordinary form.

ON THE OCCURRENCE OF THE SPINY BOXFISH (GENUS CHILOMYCTERUS) ON THE COAST OF CALIFORNIA.

BY

CARL H. EIGENMANN,

Professor of Zoölogy, Indiana University.

(With Plate LXXXI.)

During the summer of 1891 a fisherman captured a specimen of a *Chilomycterus* near San Pedro, Cal. He preserved it in alcohol and offered it for sale. The price asked was so unreasonably high that I merely took some notes of it. Since then it has been procured by the National Museum, and I am able to redescribe it. This is apparently the first notice of a *Chilomycterus* on the Pacific coast of North America.

The specimen is in good condition, and is but slightly shorter than when first seen.

Chilomycterus californiensis Eigenmann.

American Naturalist, 1891, p. 1133.

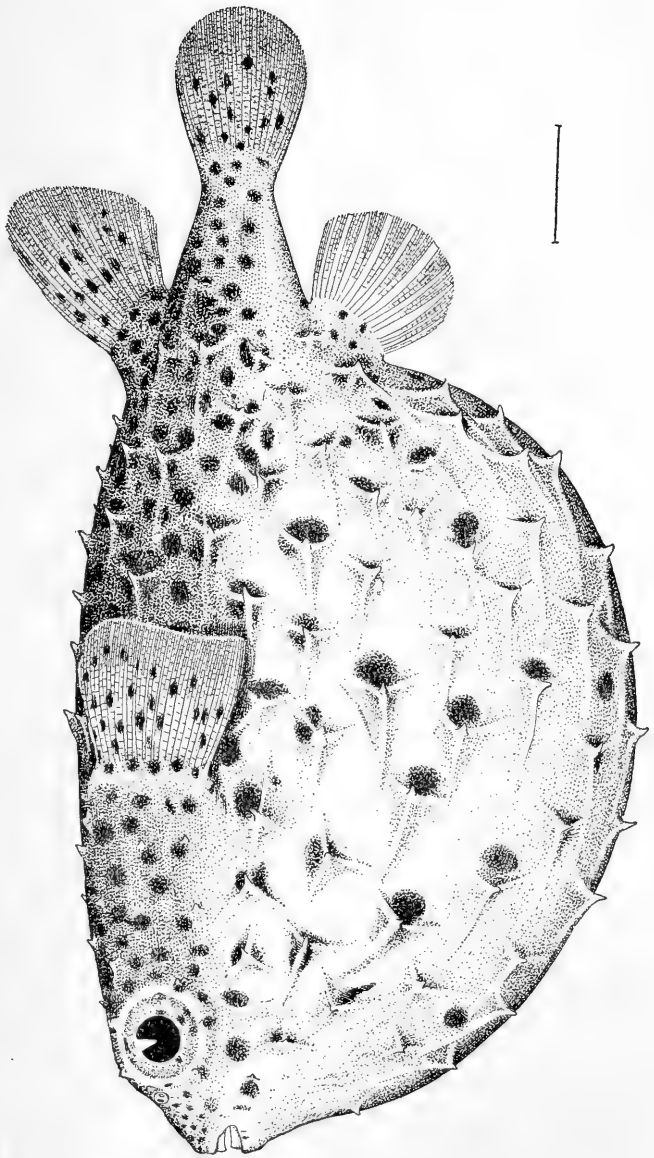
Type, No. 43860, one specimen 260^{mm} long, San Pedro, Cal., July, 1891.

Much inflatable. Face narrow, distance between eyes in front 35^{mm}; mouth narrow, 23^{mm} (33^{mm} in *C. schoepfi* of same size), protruding; margins of upper jaw making a decided angle in front; eye small, 12^{mm} in diameter (17^{mm} in *schoepfi*), superciliary edge not raised, but projecting out over the eye; interorbital very little concave.

Spines of back all low, highest between pectoral and dorsal; their anterior roots strong and raised; the spines forming the termination of these roots, giving the spines the appearance of being depressed. *Spines of the belly much larger than those of back*, the roots differing but little in size. Spines lowest on head, one above the upper anterior angle of the eye, another above the posterior angle. Two spines on head between those above the posterior margins of the eyes. A small spine midway between dorsal and caudal. Pectoral small, its base 22^{mm} high (30^{mm} in *schoepfi* of same size). Pectorals, dorsal and caudal, with numerous dark spots except at their margins; anal with a few spots at its base.

Back steel-blue merging into the white of the belly; front and sides of head with many small black spots, caudal peduncle with somewhat larger spots. Back densely covered with short streaks or bars. Sides with round spots, some as large as the eye. A black spot in center of belly, a series of three spots along the sides of the belly and a few about the anus; breast white.

BLOOMINGTON, IND., *April 25, 1892.*



CHILOMYCTERUS CALIFORNIENSIS.

DESCRIPTION OF SOME FOSSIL PLANTS FROM THE GREAT FALLS COAL FIELD OF MONTANA.

BY

WILLIAM M. FONTAINE.

(With Plates LXXXII—LXXXIV.)

In July, 1890, Mr. F. H. Knowlton and Dr. A. C. Peale made a small collection of fossil plants from the Kootanie group of Great Falls, Mont. In July, 1891, Mr. W. H. Weed made an additional small collection from the same locality. These plants have been placed in my hands for determination and description. The object of this paper is to give an account of them. Both collections can be contained in a box of moderate size, so that they can not pretend to be exhaustive.

The specimens show nothing but ferns, conifers, and one Equisetum. The conifers have but few species, and the specimens illustrating each species are few and poorly preserved. They indicate considerable maceration, as if they had been floated in water a long while before they were covered with sediment.

The ferns predominate in the number of species, while the specimens illustrating the species are in several cases very numerous. They are usually well preserved and appear to have been speedily entombed in sediment.

Both Mr. Knowlton and Mr. Weed seem to have failed to find cycads, the other constituent of a typical Mesozoic flora. They, however, exist at the Great Falls locality, for Dr. Newberry, in his excellent paper on the flora of this group,* has mentioned and described several. Besides these a beautiful impression of a cycad, obtained by Mr. R. S. Williams from this field, is figured and described in this paper.

The cycads, however, so far as I can learn, are rare in this flora. Perhaps this is accounted for by the localities in which they grow and by the accidents of preservation. The condition of the fossil conifers found in this field, and their small proportion in the sum total of the Great Falls plants, indicate that the inhabitants of the higher and drier regions were not favored in preservation so much as the ferns, which presumably lived in the marshes and near to the water receiving sediment. Then, too, it is quite possible that additional discoveries may add largely to both the conifers and cycads. Negative conclusions,

* "Flora of the Great Falls Coal Field, Montana." Amer. Jour. Sci., vol. XLI, March, 1891, p. 191.

based on the presumed absence of groups of plants, can not be fairly drawn until it is made certain that no further discoveries can be looked for.

With regard to the age and affinities of this flora, my investigations add nothing to the conclusions arrived at by Dr. Newberry in the paper before cited. These conclusions, which I fully indorse, are that the Potomac group, the Great Falls group, the Kootanie group of Canada, and the Kome group of Greenland are all of the same general age. Dr. Newberry expresses the opinion that the Great Falls strata are somewhat older than those of the Potomac, this being indicated by the absence of angiosperms in the former. This opinion is justified if we take into consideration only the plants found in the Great Falls strata up to this time. But it is possible that, if these beds have not been exhaustively explored, angiosperms may yet be found in them. The strata seem to some extent to show an isolation of forms, and a confinement of them to particular horizons. This would seem to be the case with the cycads. As stated before they do exist in the strata at a particular horizon, or at a particular locality, while in the two collections before me not a single imprint is found. In my collecting from the Potomac beds, I did not discover the angiosperms of modern type that they yield until towards the close of my explorations, long after large collections of plants of older types had been made. The more modern angiosperms of the Potomac are found in the upper beds of the formation, which have been in most places carried away by erosion There are localities in the Potomac of Virginia which show good exposures of thick beds, that abound in impressions of ferns and conifers, but contain no angiosperms. The two near Potomac Run described in Monograph XV of the U. S. Geological Survey, as "Roadside" and "Hillside," have this character. It is noteworthy that *Osmunda dicksonioides*, a plant that seems to be abundant at a certain horizon in the Great Falls field, is found at one of these localities and nowhere else in the Potomac beds. If the age of the Potomac strata had been determined from the fossils of these localities, it would, from the absence of angiosperms, appear older than it is.

With regard to the age of the Potomac itself perhaps a word may be allowed here. It is to be understood that by Potomac is meant the lower member of that formation, as shown chiefly in Virginia. I do not regard this member as all of Wealden age. The period of its deposition seems, if we are to judge by the progress made by the plants, to have extended through the Wealden into the Urgonian, and perhaps to a somewhat later time. It was probably extended throughout the Neocomian. The very remarkable isolation and grouping of the plants of the Virginia Potomac, which seems in a measure to exist in the Great Falls field, and the great differences in the relative abundance of the different types, appear to indicate unstable conditions in the different elements of the flora, and also rapid changes. It is quite possible, then,

that higher types of plants were reached in these strata than in any synchronous with them in Europe.

Returning to the consideration of the constituent groups of plants in the Great Falls flora, we find the ferns decidedly dominant, but different species are by no means equally represented. At the head of the list in number of specimens stands *Aspidium montanense*, a new species. Next to this, and in about the order of naming, come *Aspidium monocarpum*, also a new species, *Thyrsopteris rarinervis* Font., and *Osmunda dicksonioides* Font. These were all apparently abundant. To judge from the character of the rock which bears the imprints, these did not all occur on the same horizon. *Osmunda dicksonioides*, for example, occurs in a material very different from that which shows the imprints of *Aspidium montanense*.

In this connection I will repeat an opinion expressed before. In determining the age of an unknown group of fossil plants, greater weight as evidence of age ought to be assigned to some plants than to others. These are the plants whose fossils have marked and salient features that permit them to be identified without danger of error. An example of this kind of plant is *Frenelopsis*, especially *F. parceramosa*, of the Potomac flora. When these are fully established and at home in a formation, as would be shown by their general distribution and the abundance of the fossil specimens that they afford, they ought not to be counted simply as units in a sum total to establish a percentage. Their evidence would thus be neutralized by that of other units which are newcomers or belated survivors. This is especially true of floras in a critical stage of evolution, and which contain considerable numbers of newcomers and survivors. The Potomac flora was one of this character, in which Jurassic types were being cast out and Cretaceous ones introduced. If the era of deposition of the Great Falls beds was nearly that of the Potomac, as is most probable, then the flora of the time must have been likewise in an unstable condition.

So far as yet made out, the ferns seem to be the most common plants in the Great Falls flora. The above remarks, owing to the character of this type of vegetation, and to its long persistence with but little change, do not apply to them so well as to many of the forms found in the Potomac flora. *Thyrsopteris rarinervis*, however, is a fern that has a well-marked facies, which is not possessed by many ferns. Its abundance in the Great Falls strata gives it great weight in establishing a resemblance between the Potomac and Great Falls floras.

Equiseta appear to have been very rare in the flora now in question. The few imprints that are found are very poorly preserved, and seem to have been made by fragments that had floated a long time in water.

The two collections yield the following species:

Equisetum Lyelli? Mantell.

Only one imprint was seen that was clearly that of an Equisetum. It occurs in a ferruginous, sandy shale. It is too poorly preserved to

permit positive determination. In size and general character it is so close to *Equisetum Lyelli* that the identification with that species is quite probable. Two or three other imprints of stems occur that may be those of Equisetum, but they are too obscure to be determined even generically.

Aspidium montanense, nov. sp.

Pl. LXXXII, Figs. 1–3; Pl. LXXXIII, Figs. 2, 3 3, 3*a*.

Plant probably arborescent. Fronds large, probably attaining the dimensions of several feet, tripinnatifid or tripinnate. Pinnæ alternate, sometimes nearly opposite. Rachises of all orders strong and rigid. Leaf substance thick and durable. Normal pinnules, or those of the middle portion of the fronds and pinnæ, oblong, slightly falcate, obtuse to subacute, attached by a somewhat widened base, united at the base, inserted under an angle of 45° to 50°. Mid nerves of the pinnules distinct, continued to near their tip, and forking at the summit. Lateral nerves slender, single, arching towards the summit of the pinnules with the basal ones sometimes once forked. The pinnules of the lower part of the frond are lobed or toothed, with lobes and teeth similar in shape to the normal pinnules. Towards the upper or terminal portion of the frond the ultimate pinnæ pass, by continued diminution, through lobed and toothed pinnules into entire ones. Sori in two rows, one on each side of the midrib of the pinnules, obovate in form, attached to the summit of lateral nerve and placed midway in the lamina of the pinnule.

This fern is represented in the collections by numerous well-preserved specimens, which show all parts of the frond. Pl. LXXXIII, Fig. 2, represents the normal pinnules. Pl. LXXXII, Fig. 1, gives the pinnules from the lower part of the frond. Fig. 3 shows dentate pinnæ, passing into pinnules, from the upper part of the frond. Pl. LXXXIII, Fig. 3, shows lobed pinnæ from the upper part of the frond, and Pl. LXXXII, Fig. 2, gives fragments of a fructified compound pinna.

This plant shows considerable variation in the ultimate pinnæ and pinnules taken from different parts of the frond. In the general character of its pinnules it stands midway between two ferns from the Potomac of Virginia. These are *Aspidium fredericksburgense* Font., and *Pecopteris strictinervis* Font. Some of the specimens, taken by themselves, might easily be mistaken for the one or the other of these species. I think that the fern that I reported to Dr. Newberry as *Aspidium fredericksburgense* (see p. 193 of his paper) is a form of the species now described. The fructification is much like that of *Aspidium pinnatifidum*.*

Aspidium monocarpum, sp. nov.

Pl. LXXXIII, Figs. 4–6, 6*a*; Pl. LXXXIV, Fig. 3, 3*a*.

Frond tripinnate. Pinnæ alternate. Pinnules of the lower part of the frond attached by a much widened base, inclined strongly forward,

*U. S. Geol. Survey, Monograph XV, Pl. XXI, Fig. 15*a*.

very slightly falcate, united to a considerable distance from the base, acute to subacute. Mid nerve slender but distinct, splitting into branches at the summit. Lateral nerves single. The ultimate pinnæ, in ascending toward the summit of the frond, pass through pinnæ with ovate acute lobes into those with serrate toothing, and finally into entire pinnules.

Sori, seen only on serrately toothed pinnæ, are very large, single in each segment or tooth, globose or subreniform in shape, attached to a club-shaped receptacle that is borne on the summit of a basal lateral nerve, which is directed obliquely upwards. They occupy the greater portion of the upper half of each segment or tooth. Nerves of the fertile pinnæ in a bundle in each segment or tooth, and splitting up flabellately into branches.

This fern, as shown in the fructification, is a new species. There are numerous good imprints of it, so that its character can be made out pretty well. It occurs in the same yellowish gray sandy shale that carries *Aspidium montanense.* Some of the sterile forms approach so near to some of *Aspidium montanense* that they can with difficulty be distinguished. The fructification, however, is entirely different. The pinnules and segments of this fern have more of the aspect of Cladophlebis than any form of *A. montanense.* They are more acute, more inclined forward, and have a broader base than those of the last-named fossil.

Pl. LXXXIII, Fig. 6, shows a fragment of a compound pinna from the lower part of the frond, and Fig. 6ª a portion of the same enlarged. Fig. 4 gives the ovately and serrately toothed pinnæ or pinnules from the upper part of the frond. Fig. 5 gives the termination of a compound pinna. Pl. LXXXIV, Fig. 3, gives a portion of a fertile compound pinna, and Fig. 3ª a fertile fragment enlarged to show sori and nerves.

Different portions of this fern, if taken alone, could be with difficulty distinguished from several Potomac plants. Some of the serrate toothed forms are exactly like some of the forms of *Pecopteris virginiensis;* some of the ovately lobed pinnæ much resemble some of the forms of *Aspidium heterophyllum.* In size and structure the sori are like those of *Polypodium fadyenioides* of the Potomac strata. The mode of attachment of the sori and the nervation of the fructified forms of *Polypodium dentatum* of the Potomac resemble those features in this fern, but the sori of the Potomac plant are smaller and of different shape.

Aspidium angustipinnatum Font., var. **montanense**, var. nov.

Pl. LXXXIV, Figs. 1, 1*a*.

This fern is represented by six imprints, some of which are well preserved and well characterized. Although somewhat different, it agrees in all essentials so well with *Aspidium angustipinnatum* Font., of the Virginia formation, that I do not think that they should be considered

as distinct species. Fig. 1 shows the normal forms of the specimens. These differ from the Virginia plant perhaps enough to make the Great Falls forms a variety. They do not, however, show any fructification. Most of the specimens are in a ferruginous rock, which is the material carrying the imprints of *Osmunda dicksonioides*. This appears to come from a different horizon from that yielding *Aspidium montanense*. Some of the forms approach pretty closely to some of those of the last-named plant, but the toothing of the pinnules is different. The normal pinnules are long and slender, rather remote, somewhat constricted at base, with the lower side decurrent by a narrow wing, which, in most of the pinnules, unites with the base of the next lower one. The margins show a shallow crenate toothing. The nerves are in the main like those of the Potomac plant. They are single in each crenate lobe, forking about midway their length, and diverging widely in the lobes.

Pecopteris montanensis, sp. nov.

Pl. LXXXIII, Fig. 1, 1*a*.

Frond bipinnate to bipinnatifid. Leaf substance thick, ultimate pinnæ alternate and subopposite. Rachises of different orders strong. Lower pinnules small, united at base for some distance up, spatulate to broadly elliptical in form, subacute, strongly convex in outline on the upper outer margin. Pinnules of the upper part of the frond and terminal portions of the ultimate pinnæ still more united, narrowly elliptical in form. Nerves single in each pinnule and lobe, strong, once forking, with branches widely diverging, the anterior branch ending in the tip of the pinnule or lobe and the posterior one in the upper outer margin.

This small fern is well characterized and seems to be new. As it shows only two specimens its full character can not be made out. For this reason I place the plant provisionally in the genus Pecopteris, as in foliage it is most nearly connected with it. In the form of its pinnules it is much like *Pachypteris ovata* Brongn., but the leaf substance is much thinner and the nerves are different. Fig. 1 gives pinnæ from the lower part of the frond and 1*a* gives several pinnules enlarged to show nervation.

Pecopteris Browniana? Dunker.

Five imprints of small fragments of a fern very near to *Pecopteris Browniana*, and most probably identical with it, occur in the collections. Most of them are in a ferruginous sandy shale of reddish color, which is the material that carries the impressions of *Osmunda dicksonioides*. These differ slightly from those that occur in grayish shale, which are nearer the typical forms. They are, however, imprints of the terminal portions of compound pinnæ, a part of the frond that usually shows much variation in the shape of the pinnules. The pinnules of these are

broader and proportionally somewhat shorter than the normal ones of this fern. All the forms, however, are near enough to *Pecopteris Browniana* to permit their assignment to that species with a high degree of probability.

Cladophlebis heterophylla sp. nov. Pl. LXXXIV, Fig. 2.

Fronds bipinnate. Rachises stout and rigid. Pinnæ alternate, the basal ones much reduced in size, forming pinnules with a few broad, rounded and shallow lobes. Pinnules united at base, the lower ones of the pinnæ orbicular in shape, the others subquadrilateral, attached by a much broadened base, united at base, falcate, usually very obtuse and remote. Basal inferior pinnule of each pinna larger than the rest, showing three shallow rounded lobes, the lobation becoming less distinct in the upper part of the frond. Nerves not seen distinctly, but apparently forming a bundle that splits up flabellately into branches.

Fig. 2 gives the largest specimen of this fern. The basal inferior pinnules of the pinnæ are quite different from the rest. They are much larger and approximate in form the basal pinnæ, although much smaller than these. The general plan of the nervation, so far as it could be made out, is similar to that of the Acrostichides of the older Mesozoic of Virginia. The shape and size of the pinnules are like those of *Acrostichides microphyllum* of that formation. In the general character of the pinnules it may be compared also with *Cladophlebis parva* of the Potomac formation.

I think that this is the plant reported by me to Dr. Newberry as *Cladophlebis parva*, but the additional specimens show differences enough to separate them. In the absence of fructification, it would go more naturally into the genus Cladophlebis.

In size and the form of its pinnules, it resembles some of the small Gleichenias given by Heer from the Kome beds, and it is quite possible that fructification may be found that will show it to belong to that genus. Only two specimens were found, and its full character, even for the sterile forms, can not be regarded as made out.

Osmunda dicksonioides Font.

Numerous specimens of this fern occur. The imprints are in a ferruginous, indurated shale. They coincide exactly with the Potomac plant. This fossil, to judge from the character of the rock which contains it, occurs at a different horizon from *Aspidium montanense*. It must have been abundant in the Great Falls flora. The fructified form was not seen.

Thyrsopteris microloba? var. **alata** Font.

Two small specimens of a fern closely resembling the Potomac plant, *Thyrsopteris microloba*, var. *alata*, were seen in the collections. The

amount of material is not sufficient to permit positive identification, but in any case this fern is very near the Potomac plant and is of the same type.

Thyrsopteris rarinervis Font.

This fern shows numerous imprints. Some of them are very fine, being much better than any from the Potomac beds. Some of the forms approach more nearly Heer's *Asplenium dicksonianum* than do those of the Potomac fossils. The resemblance was seen in the latter fossils but, as stated, it was not so marked as in some of the Great Falls imprints.

Sequoia ambigua? Heer.

The collections contain three small and poorly preserved fragments of a conifer which is most probably *Sequoia ambigua*. Some of the leaves are preserved and are identical with those of that species. The amount of material does not permit a positive determination.

Sequoia rigida Heer.

There are in the collections four pretty well preserved impressions of a conifer that can not be distinguished from *Sequoia rigida*.

Sphenolepidium virginicum, Font.

Eight impressions of a conifer identical with *Sphenolepidium virginicum* of the Potomac formation were obtained. Most of them are poorly preserved and show a good deal of maceration, as if they had been floated long in water. To judge from the number of impressions of this plant that were found it must have been somewhat common in the Great Falls flora, standing next to *Taxodium ramosum*.

Taxodium (Glyptostrobus) ramosum Font.

This conifer shows twelve specimens. They are the best preserved of the coniferous fossils, giving in most cases the character of the plant quite distinctly. The specimens of it are more numerous than those of any other conifer of the Great Falls flora. It occurs along with the two preceding conifers and with *Thyrsopteris rarinervis* and *Aspidium montanense*, in a sandy shale.

Zamites montanensis sp. nov.

Pl. LXXXIV, Fig. 4.

Mr. R. S. Williams, of Great Falls, loaned Mr. Knowlton a beautiful imprint of a cycad which seems to be new. A drawing of it was made and is given in Pl. LXXXIV, Fig. 4, of this paper.

I have not seen the original, but the drawing gives the character so distinctly that a description can be given from it. The description is as follows: The leaf (compound) is narrowly elliptical in outline and small. It is abruptly pinnate, with a stout rigid midrib. The lower leaflets are lancet-shaped, short, remote, and stand at right angles with

the midrib. In ascending towards the tip of the compound leaf, the leaflets become linear in shape and are more closely approximate, until they touch. They are also nonfalcate, and toward the end of the leaf are obliquely attached to the midrib. The leaflets of the central part of the leaf are longest, giving the elliptical outline. Nerves, three in number, strong, parallel with each other and the margins of the leaflets.

The imprint shows the under side of the leaf uppermost, so that the midrib conceals the insertions of the leaflets. Taking as correct Heer's distinction between Zamites and Pterophyllum,* this imprint does not show positively which of the two it is. It seems, however, to agree best with Zamites and may provisionally be put in that genus. In the form of its leaflets it is quite near *Zamites speciosus* Heer,† agreeing pretty well with some of the features of the smaller forms of that species, but the leaflets are proportionately broader. The basal leaflets also are quite different, and the gradation from these into those higher up is not seen in Heer's plant.

As stated before, it is somewhat singular that neither Mr. Knowlton nor Mr. Weed seems to have discovered cycads. This certainly indicates that they are not generally distributed in the Great Falls strata, but are limited to particular horizons.

UNIVERSITY OF VIRGINIA,
February 10, 1892.

PLATE LXXXII.

Fig. 1. Aspidium montanense, n. sp. Pinnules from the lower part of the frond.
Fig. 2. Aspidium montanense, n. sp. Fragments of a fructified compound pinna.
Fig. 3. Aspidium montanense, n. sp. Detached pinnæ from the upper part of the frond.

PLATE LXXXIII.

Fig. 1. Pecopteris montanensis, n. sp.
Fig. 1*a*. Magnified portion of Fig. 1.
Fig. 2. Aspidium montanense, n. sp. Normal pinnules.
Fig. 3. Aspidium montanense, n. sp. Lobed pinnæ from the upper part of the frond.
Fig. 3*a*. Aspidium montanense, n. sp. Enlarged portion of Fig. 3.
Fig. 4. Aspidium monocarpum, n. sp. Serrate toothed pinnæ or pinnules from the upper part of the frond.
Fig. 5. Aspidium monocarpum, n. sp. The termination of a compound pinna.
Fig. 6. Aspidium monocarpum, n. sp. Pinnules from lower part of the frond.
Fig. 6*a*. Aspidium monocarpum, n. sp. Enlarged portion of Fig. 6.

PLATE LXXXIV.

Fig. 1. Aspidium angustipinnatum Font., var. montanense, n. var.
Fig. 1*a*. Enlarged portion of Fig. 1.
Fig. 2. Cladophlebis heterophylla, n. sp.
Fig. 3. Aspidium monocarpum, n. sp. Showing fertile portion of frond.
Fig. 3*a*. Enlarged portion of Fig. 3.
Fig. 4. Zamites montanensis, n. sp.

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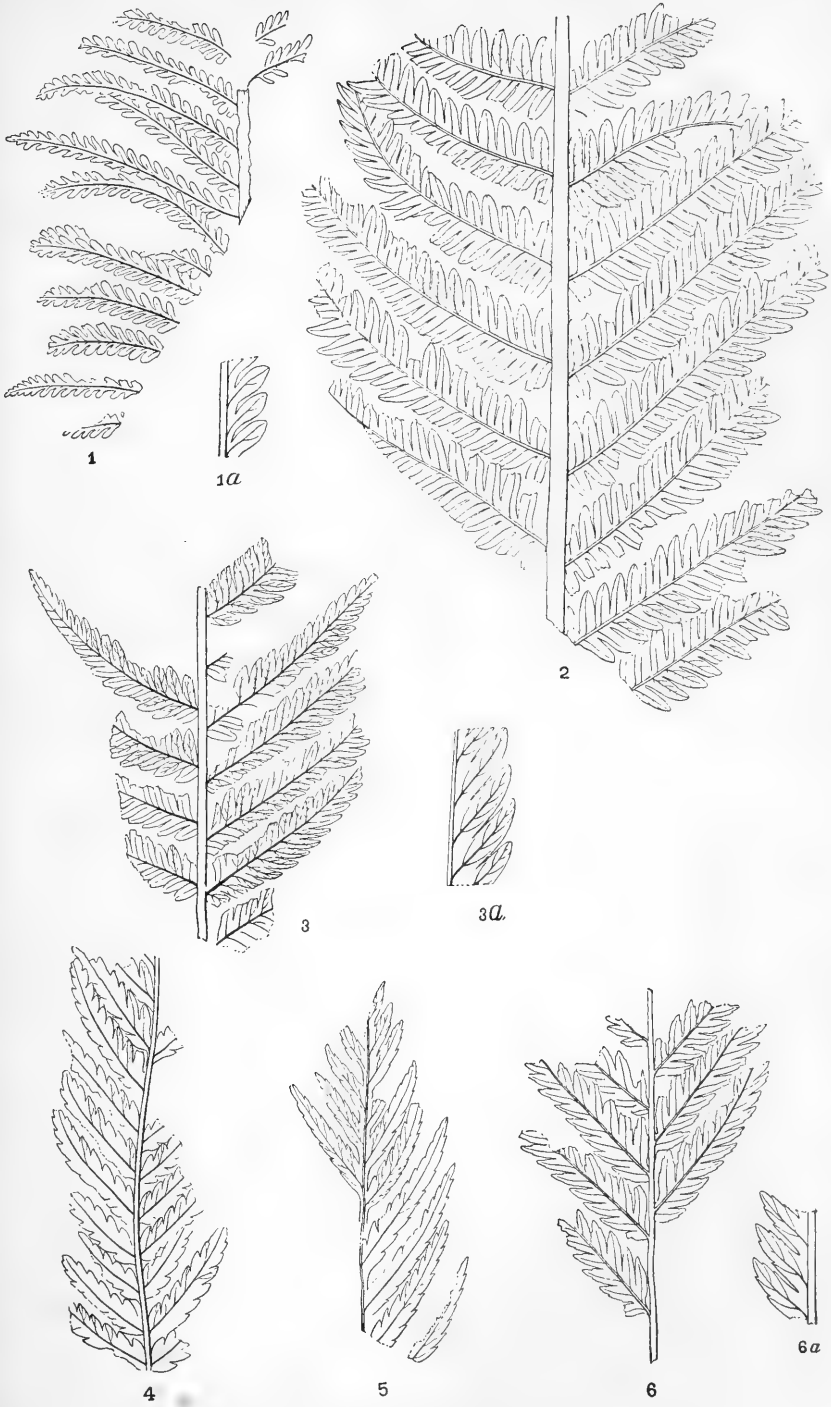
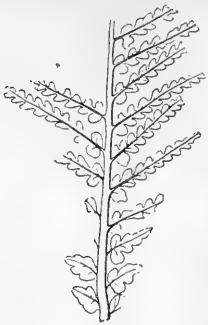
*Flor. foss. arct., vol. III, p. 62.

†Flor. foss. arct., vol. III Die Kreideflora de arctischen Zone, Pl. XIV, Fig. 11.

Aspidium montanense, new species.



1. *Pecopteris montanense*, new species.
2, 3. *Aspidium montanense*, new species.
4, 5, 6. *Aspidium monocarpum*, new species.



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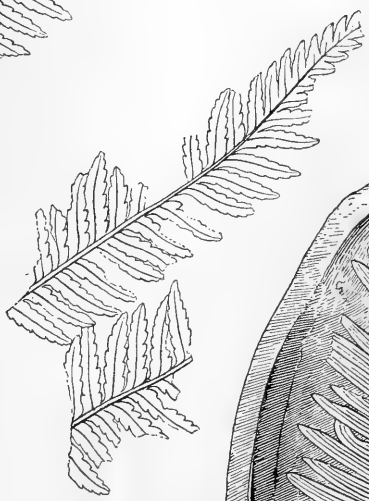

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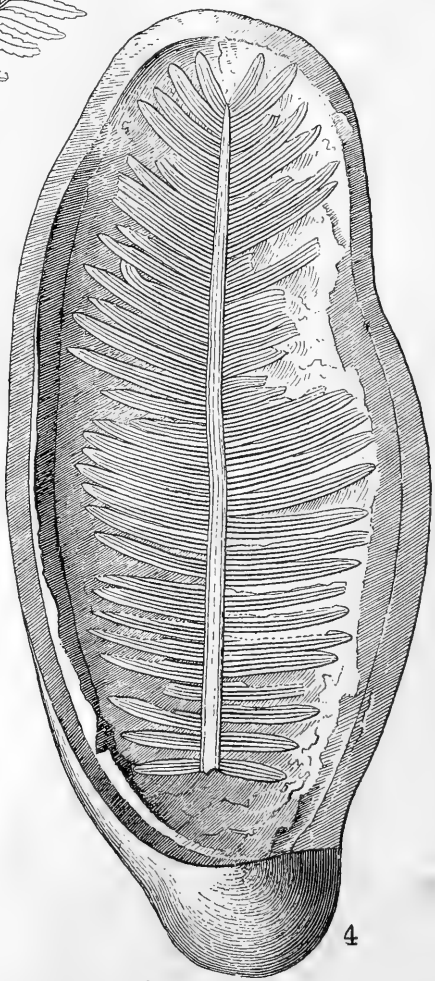

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3

3a

1. *Aspidium angustipinnatum*, var. *montanense*, new variety.
2. *Cladophlebis heterophylla*, new species.
3. *Aspidium monocarpum*, new species.
4. *Zamites montanensis*, new species.

ALPHABETICAL INDEX.

A.

	Page.
Abalone shells	198
Abbott, Dr. C. C., on eggs of garter snake	388
cited	392
Abbott, Dr. W. L., African mammals collected by	445
Abbott's antelope from East Africa	473
Abeona minima	155
Acanthis linaria holbœllii	354
Acanthopleuridæ, California species of	196
Acanthopneusto ijimæ, new species of	372
Acara bartoni, new species	286
figure of	287
Acmeidæ, California species of	197
Acmæa, California species of	197
Acila, subgenus	192
Acridotheres cineraceus	352
Actaeonidæ, California species	195
Actaeon (Rictaxis) punctocælatus	195
Adula, subgenus	192
Ægithalos caudatus	345
Æpyceros melampus	472
Africa, collection of mammals from	445
Agassiz, Louis, cited	380
Agkistrodon piscivorus, breeding habits of	386
Agonidæ, California species of	171
Alaska, Chinese relics from	221
corystoid crabs from	223
hermit crabs from	1
Alauda blakistoni, measurements of	304
japonica, measurements of	302
Albatross, steamer, explorations by	8, 23, 121, 223
Albula vulpes	135
Albulidæ, California species of	135
Alcelaphus cokii	471
Aleutian Islands, hermit crabs from	3
Algansea dugèsi, new species	283, 287
Allen, Dr. Harrison, on new genus of bats	441
new subfamily of bats	437
Temminck's bat	443
Allen, J. A., cited	386
Alopias vulpes	134
Alopiidæ, California species of	134
Amalthea, California species of	204
Amaltheidæ, California species of	204
Amphissa, California species of	213
Amphissa bicolor, new species	213
Amphistichus argenteus	156
Anatinidæ, California species of	184
Andrews, Mrs. George, unios collected by	406, 410
Anisotremus davidsoni	152
Anodonta Cooperiana	433
imbecillis	433
Anomia lampe	194
Anomiidæ, California species of	194
Antelope, Abbott's	473
black-fronted	476
Damara-land pygmy	477
new species of	473
Pallah	472
Zanzibar pygmy	477
Anthoxanthum odoratum, Holm on	399
figure of	402
Anthus maculatus	314
Arca, California species of	192
Arcidæ, California species of	192
Ardea herodias, parasites of	87
Argonauta pacifica	217
Argonautidæ, California species of	217
Arizona, Wolpai maiden of	29
Ascaris spiculigera	89
Ascaris serrata, figure of	110
Ashmead, W. H., on Encyrtinæ	361
Aspidium angustipinnatum montanense, new variety	491
montanense, new species	490
monocarpum, new species	490
Assiminea californica	205
Atherinidæ, California species of	145
Atherinops affinis	146
Atherinopsis californiensis	145
Auchenopterus integripinnis	173
Auckland Island, crabs from	243
Aulacodus swinderianus	468
Auriculidæ, California species of	196
Avian entozoa, Linton on	87
Avicula peruviana	193
Aviculidæ, California species of	193
Axinæa intermedia	192

B.

Bahama Islands, crabs from	231
Baldwin, A. H., drawings by	232
Bandfish in California	173
Barlow, J. G., insects collected by	367
Barracuda in California	147
Barrett, J. P.	411
Bascanion constrictor, breeding habits of	396

	Page.
Basileuterus rufifrons, new species	119
dugèsi, new subspecies	119
jouyi, new subspecies	119
Bass, black sea, in California	151
kelp, in California	150
rock, in California	150
Bat, Temminck's	443
Batrachidæ, California species of	171
Batrachians and reptiles, new species of	115
Bats, new genus of	441
new subfamily of phyllostome	437
Baur, Dr. G., turtles described by	379
Bean, Tarleton H., on new species of stargazer	121
on new species of fishes from Mexico	283
Beauvois, M. Palisot, cited	387
Belonidæ, California species of	143
Benedict, James E., on new species of hermit crabs	1
corystoid crabs	223–230
Bering Sea, crabs from	18
Bermuda Islands, crabs from	249
Birds, collection of, from Japan	289
new Japanese species of	342, 371
species of	27, 119
subspecies of	347
parasites of	87
Bittium, California species of	205
Bivonia compacta	204
Blasius, Dr. Wilh., quoted	349
Blatchley, Prof. W. S	395
Blenniidæ, California species of	171
Blind fishes of California	160
Blood ejected from eyes of toad	375
Bok, bosch, of East Africa	471
Bolles, Lieut. T. Dix, on Chinese relics in Alaska	221
Boreal America, noctuidæ of	33
Boreotrophon, subgenus	216
Boulenger, Dr. G. A., cited	379
Bourke, Capt., quoted	29
Brachiopoda, California species of	182
Brachyistius frenatus	155
Bragg, L. C	161
Branchiostoma elongatum	132
Branchiostomidæ, California species of	132
Brazil, crabs from	265
Bristol Bay, hermit crabs from	16
British Columbia, crabs from	18
Museum	37
Brook trout of California	482
Bruce, Mr., Colorado insects from	38
Bubalis caffir	478
Buccinidæ, California species of	216
Buckley, S. B., unios collected by	417
Buffalo, cape	478
Bulla nebulosa	195
Bullidæ, California species of	195
Bumpus, Dr. H. C., cited	389, 392

C.

	Page.
Cæcum crebricinctum	204
Cæsiosoma californiense	152
California, fishes of	123
golden trout of	481
gulf of, crabs from	5
Lower, crabs from	238
marine shells of	179
new hermit crabs from	22
spiny boxfish of	485
Cæcidæ, California species of	204
Call, R. E., unio collection of	406
Calliostoma, California species of	201
Callista, California species of	187
Calocerinus floridanus	368
new insect genus	368
Calyptraeidæ, California species of	203
Cancellaria cooperi	211
Cancellariidæ, California species of	211
Canis mesomelas	455
Cantharidus pupoideus	202
Caprimulgus jotaka, measurements of	293
Caranx chrysus caballus	149
Carcharhinus glaucus	133
lamiella	133
Cardiidæ, California species of	189
Carditidæ, California species of	190
Cardium, California species of	189
Catablemella brachychir	142
Cathetostoma albigutta, new species	121
Caulolatilus princeps	158
Cavolinia tridentata	194
Cavoliniidæ, California species of	194
Central America, birds from	27
Cephalophus niger	475
nigrifrons, dimensions of	476
spadix, new species	473
Cephalopoda, California species of	217
Cercopithecus albogularis	448
sabæus	449
Cerithidea californica	205
Cerithiidæ, California species of	205
Cerithiopsidæ, California species of	210
Cerithiopsis, California species of	210
Ceryle guttulata, measurements of	295
lugubris, measurements of	294
Cestoda from Yellowstone Park	99
Chætodipterus faber zonatus	158
Chætopleura, California species of	196
Challenger expedition, crabs collected by	248
Chama, California species of	189
Chamidæ, California species of	189
Characodon variatus	286
Cherrie, George K., on new species of flycatchers	27
Chilomycterus californiensis	175, 485
Chinese relics from Alaska	221
Chione, California species of	188
Chiridæ, California species of	162
Chloris kawarahiba minor	355
Chlorostoma, California species of	200
Chorus Belcheri	216
Chromis punctipinnis	158
Chrysodomus (Kellettia) Kelletti	216
Cichloselys sibiricus	317
Cinclus pallasii	347
Circus cyaneus hudsonius, parasite of	88
Citharichthys sordidus	174

	Page.
Cladophlebis heterophylla, new species	493
Clangula albeola, parasites of	87
Clevelandia longipinnis	159
Clidiophora punctata	183
Clinus evides	173
Clupea mirabilis	135
sagax	136
Cupeidæ, California species of	135
Coccothraustes japonica, measurements of	358
Cod, rock, of California	165
Colobus caudatus	447
guereza, measurements of skull of	448
Coluber, breeding habits of	395
Columbella, California species of	213
Columbellidæ, California species of	213
Colymbus holbœllii	289
Conidæ, California species of	208
Connecticut, crabs from	236–275
Connochætes taurinus albojubatus	470
Conus, California species of	208
Cooper, Dr. J. G.	179, 217
Cooperella, subgenus	186
Cope, E. D., cited	380
Copipanolis, characteristics of	61
Copperhead snakes, breeding habits of	386
Copipanolis borealis, new species	62
cubilis	63
fasciata, new species	62
stigma	63
Corbula luteola	183
Corbulidæ, California species of	183
Corolla spectabilis	194
Coronado Islands, fishes of	123
Cortes Banks, fishes of	123
Corystoid crabs, Benedict on	223
Costa Rica, new species of birds from	27
Cottidæ, California species of	168
Coues, Dr., cited	389
Couper, J. H., unios collected by	413
Cox, Prof. U. O., cited	395
Crabs collected by North Pacific Exploring Expedition	232
Corystoid, Benedict on	223
new species of	1, 231
of the family Pericerida, Miss Rathbun on	231
Cragin, Prof. F. W., cited	392
Crepidula, California species of	203
Crocidura from East Africa	470
Crossarchus mungo, dimensions of skull of	453
Crotalidæ, breeding habits of	386
Crotalophorus miliarius, eggs of	388
Crucibulum, California species of	203
Cryptomya californica	183
asteroides	42
bistriga, new species	48
characteristics of	33
cinderella, new species	49
convexipennis	38
dorsalis, new species	47
florea	44
geographical distribution of	33
illustrations of genitalia of	52
intermedia	48
lætifica	45
Cucullia montanæ	40
obscurior, new species	41
postera	43
revision of the genus	33
serraticornis	50
similaris, new species	41
solidaginis	52
speyeri	46
Cuculus kelungensis	293
Cumingia californica	186
Cyanoptila bella	328
Cyclostrematidæ, California species of	202
Cynoscion parvipinne	154
Cypræa spadica	207
Cypræidæ, California species of	207
Cyprinidæ, California species of	135
Cymatogaster aggregatus	155
Cymbuliidæ, California species of	194
Cynoscion nobile	154
Cyprinodontidæ, California species of	142
Cythara, subgenus	208

D.

Dall, William H., Alaskan crabs collected by	223
on new species of shells from San Pedro Bay	179
Damalichthys argyrosomus	157
Dasybatidæ, California species of	134
Dasybatis dipterura	135
Dead Man's Island, shells at	180
Dean, Rev. A., unios collected by	406, 416
Delphinulidæ, California species of	199
Dendrohyrax validus, dimensions of	457, 458
figure of shell of	480
Dendromys nigrifrons, new species	462
Dentalium, California species of	194
Denton, S. F., on horned toads	377
Desmognathidæ, new genus of	115
Diaphus theta	140
Dibothrium cordiceps	99, 112
exile, new species	100
Dicopinæ, revision of	53
Dicopis, characteristics of	54
Dicopis electilis	57
grotei	55
thaxterianus	58
virideseens	56
Diodon hystrix	175
Diodontidæ, California species of	175
Diplodonta orbella	190
Diplodontidæ, California species of	190
Distomum flexum, new species	98, 112
verrucosum, new species	96, 111
Dobson, Dr., megaderma collected by	469
Dolichotoma, section	207
Donax, California species	186
Doubleday, E., insect from	56
Dow, Capt. John, crabs collected by	272
Downie, T. C., unios collected by	413
Drillia, California species of	208
Dryobates japonicus	299
subcirris	299
Dryocopus martius	301
Duges, Prof. Alfredo, fishes collected by	283

E.

Page.

East Africa, mammals from 445
Echeneididæ, California species of 148
Echinorhynchus rectus, new species 91, 110
striatus 92, 111
Ectophylla, new genus of bats 441
alba, new species of bats 442
Eggs of California fishes 127
snakes, Hay on 385
Egg-tooth of snakes 386
Eichler, A. W., cited 400
Eigenmann, Carl H., on fishes of San Diego, Cal 123–178
spiny boxfish 485
Elassochirus, subgenus 1, 19
Eleotragus arundinaceus 472
Eliomys murinus, measurements of 459
Elliott, Bishop, unio collection of 412
Embryology of California fishes 123
fishes, illustrations of 178
Embiotoca jacksoni 156
Embiotocidæ, California species of 155
Emmons, E., unios collected by 429
Emys geographica 381
pseudo-geographica 380
Encyrtinæ with branched antennæ, L. O. Howard on 361
Entozoa, avian, Linton on 187
Eopsetta jordani 174
Ephippidæ, California species of 158
Epision, new genus 100
plicatus, new species 101, 112
Equisetum Lyelli 489
Erato, California species of 207
Erimacrus, Benedict on 223
new genus of crabs 229
isenbeckii 229
Erinaceus albiventris 469
Ethalia in California 199
Eulima micans 209
Eulimidæ, California species of 209
Eupagurus, new species of 1
alaskensis, new species 2
albus, new species 6
aleuticus, new species 2
beringanus, new species 17
bernhardus 1
brandti, new species 9
californiensis, new species 21
capillatus, new species 8
cervicornis, new species 25
confragosus, new species 11
corallinus, new species 23
cornutus, new species 12
coronatus, new species 24
curaçaoensis, new species 21
dalli, new species 9
defensus, new species 7
exilis, new species 6
floridanus, new species 5
gilli, new species 20
gladius, new species 7
hemphilli, new species 16
hispidus, new species 26
impressus, new species 5

Page.

Eupagurus, kennerlyi, new species 19
mexicanus, new species 22
minutus, new species 14
munitus, new species 19
newcombei, new species 17
parvus, new species 26
patagoniensis, new species 3
purpuratus, new species 15
rathbuni, new species 14
roseus, new species 22
setosus, new species 19
smithi, new species 4
splendescens 2
tanneri, new species 10
tenuimanus 1
townsendi, new species 13
trigonocheirus 1
unidosus, new species 18
varians, new species 24
Eurynorhynchus pygmæus 292
Eutainia, breeding habits of 388
Eutolype, characteristics of 58
bombyciformis, new species 59
damalis 61
depilis 60
rolandi 60
Exocœtus californicus 143

F.

Falco rusticolus 292
False Bay, California, fishes of 124
Fasciolariidæ, California species of 217
Fernald, Prof., insect collection of 72
Fierasfer dubius 173
Fierasferidæ, California species of 173
Filaria serrata, new species 88, 110
Fish Commission, crabs collected by 223, 231
expeditions by .. 8, 23, 87, 121, 223
Fishes, blind, in California and Indiana 160
embryology of 178
of San Diego, Cal., Eigenmann on .. 123
new species of 12, 283
Fissurella volcano 197
Fissurellidæ, California species of 197
Fissuridea, California species of 197
Flora of Great Falls coal field 489
Florida, crabs from 236–275
new species of crabs from 5
Simpson on Unionidæ of 405
Flycatchers, new species of 27
Fontaine, William M., on fossil plants from Montana 487
Food of Wolpai Indians 30
Fossaridæ, California species of 206
Fossil shells in California 180
Fuligula vallisneria, parasites of 87, 108
Fundulus parvipinnis 142
robustus, new species 285
Fusus, California species of 217

G.

Gabb, William M., collected bats 438
Gadidæ, California species of 174

	Page.
Gadinia reticulata	196
Gadiniidæ, California species of	196
Galago crassicaudatus	450
Galapagos Islands, new crabs from	16
crabs from	273
Galeus californicus	133
Galerus mammillaris	203
Galeorhinidæ, California species of	133
Galeorhinus zyopterus	133
Gorman, Prof. Harry, on Malaclemys	382
Garrulus brandtii	353
Garter snake, eggs of	388
Gasterosteidæ, California species of	144
Gastropoda, California species of	195
Gasterosteus microcephalus	144
Gätke, Dr. H., cited	308
Gazella grantii	473
Thomsonii	473
Gazelle, Grant's, of East Africa	473
Thomson's, of East Africa	473
Thomson's figure of	480
Genetta pardina, measurements of	454
Genota, subgenus	207
Genyonemus lineatus	153
Geographical distribution of cucullia	33
unionidæ	406
Georgia, crabs from	244
unionidæ of	406
Gerres cinereus	154
Gerridæ, California species of	154
Gibbula canfieldii	201
Gillichthys mirabilis	159
Girella nigricans	152
Glottidia albida	182
Glycimeris generosa	183
Gobiidæ, California species of	159
Gobius nicholsi	159
Gobiesocidæ, California species of	171
Gobiesox eigenmanni	171
rhessodon	171
Goode, Dr. G. Brown, cited	387, 388, 390, 392, 395
Grampus, schooner, crabs collected by	236
Graptemys lesuererii	380
Grass flower, morphology of	399
Gray, Dr., antelope described by	475
Gray, Dr. J. E., cited	379
Grayson, A., Mexican birds from	119
Great Falls coal field, fossils from	488
Green, Miss Eleanor	183
Grote, Mr., on Dicopinæ	53
Guaymas, Mexico, parasites from	89, 90
Gulf of Mexico, hermit crabs from	8
new species of fish from	121
Gunther, Dr., cited	378, 477
Gymnosarda pelamys	149

H.

Hackel, E., cited	400
Haldea striatula, breeding habits of	397
Haliotidæ, California species of	198
Haliotis, California species of	198
Hallenbeck, Girard	412
Hall, Rev. A. M., snakes collected by	386, 387
Haminea, California species	195
Hargitt, Edward, cited	299
Harris, George E., salamanders collected by	115
Hartt Explorations, collection of	273
Harvey, Mr., collects golden trout	481
Hay, O. P., on breeding habits of snakes	385
ejection of blood from eyes of toad	375
turtles of genus Malaclemys	379
Hay, W. P., cited	395
Hedgehogs from East Africa	469
Heilprin, Dr., cited	390
Helogale undulata, measurements of	451
Hemichelidon griseisticta	337
Hemicardium, subgenus	190
Hemirhamphus rosæ	143
Hemphill, Henry, crabs collected by	259
Henshaw, Mr., quoted	482
Henson, Harry V., Japanese birds collected by	289
Hermit crabs, new species of	1
Herpestes caffer	452
galera, dimensions of skulls of	453
gracilis, dimensions of skull of	452
Heterodon platirhinos	392
Heterodonax, California species of	187
Heterodontus francisci	132
Heterodontidæ, California species of	132
Heterostichus rostratus	173
Hexacladia Smithii, figure of	369
description of	365
Hinnites giganteus	193
Hippoglossina stomata	174
Hippocampus ingens	144
Hirundo dasypus	338
Holbrook, Dr., cited	379
Holconotus rhodoterus	156
Holm, Theo., on morphology of grass-flower	399
Holostomum variabile	93
Holostomum variabile, figure of	111
Hopley, Miss C. C., cited	391
Houses of Navajo Indians, Dr. Shufeldt on	279
Howard, L. O., on Encyrtinæ	361
Hudson, Mr., insects from	72
Hudsonius altus	284
Hume, A., quoted	349
Hyperprosopon argenteum	156
Hypsipetes amaurotis hensoni, new subspecies	347
Hyspopsetta guttulata	175
Hypsurus caryi	156

I.

Ianthia cyanura	321
Icelinus australis	170
Ijima, Dr. I., Japanese birds from	371
Indiana, map tortoise from	379
Indian maiden of Arizona	30
Indians, marriage customs of	31
Navajo, house-building by	279
Insects, new species of	33
genera and species of	366, 367, 368
Invertebrates, marine, new species of	1
Isapis fenestratus	206
Ischnochitonidæ, California species of	196
Isesthes gilberti	171
gentilis	171

J.

Page.
Jameson, Dr. Alexander 389
Janira, section of 193
Janthinidæ, California species of 210
Janthina exigua 210
Japan, collection of birds from 289
corystoid crabs from 228
Jeffreysia, California species of 206
Jeffreysiidæ, California species of 205
Johnson, C. W., unios collected by 415, 421
Johnston, H. H., on East African mammals 446
Jones, Dr. W. H., crabs collected by 273
Jordan and Gilbert on California fishes 125
Jordan, David Starr, on golden trout of Kern river 481
cited 392
Jouy, P. L., birds collected by 326
Mexican birds collected by 119
parasites collected by 89, 91, 102
Jynx torquilla, measurements of 296

K.

Kilima-njaro, mammals from 445
King, Miss Emma 184, 198
Kinglet, Japanese 346
Kellia, California species of 191
Kellidæ, California species of 191
Kelpfish in California 173
Kendall, W. C., crabs collected by 261
Knowlton, F. H., fossil plants collected by .. 487
Kobus ellipsiprymnus 471

L.

Labiosa undulata 187
Labridæ, California species of 157
Lacuna, California species of 205
Lake Maxinkuckee, turtles from 383
Lamellaria Stearnsii 211
Lamellariidæ, California species of 211
Lampetra spadicea 283
Lanius superciliosus 348
Larus californicus, parasites of 87, 97
Larvivora cyane, measurements of 321
Lasea rubra 191
Latilidæ, California species of 158
Lazaria subquadrata 190
Le Conte, Major 409
Le Conte, cited 383
Leda cælata 192
Ledidæ, California species of 192
Leiocottus hirundo 168
Leland Stanford Junior University 483
Lepidogobius gilberti 159
y-cauda 159
Leptocottus armatus 168
Leptothyra, California species of 199
Lepus capensis 468
Le Seur, on map tortoise 379
Leucosticte brunneonucha 354
Libidochirus, subgenus 26
Libinia dubia 237, 277
emarginata 235, 277
Macdonaldi, new species 238, 277
mexicana, new species 242, 277
setosa, figure of 277
spinimana, new species 240, 277

Page.
Lima orientalis 193
Limidæ, California species of 193
Lingulidæ, California species of 182
Lintner, Dr. J. S. 37
Linton, Edwin, on avian entozoa 87
Liocardium, subgenus 190
Liotia, California species of 199
Little grebe from Japan 290
Littorina, California species of 205
Littorinidæ, California species of 205
Lithophagus plumula 192
Long Island, crabs from 236–275
Lottia gigantea 197
Lucapinella callomarginate 198
Lucapina crenulata 193
Lucina, California species of 190
Lucinidæ, California species of 190
Lutricola alta 186
Lyonsia californica 184

M.

Macoma, California species of 185
McConnell, A. E. 223
McDonald, Hon. Marshall 87
new species in honor of 240
Macrocœloma camptocera 249, 277
diplacantha 250
entheca 251
septemspinosa 250
subparallela 250
tenuirostra, new species 252, 277
trispinosa 249
Macron lividus 216
Mactra, California species of 187
Mactridæ, California species of 187
Malaclemys, O. P. Hay on genus 379
Malacoclemys lesueurii 380
Mammals, True on African 445
Mangilia, California species of 208
Manta birostris 135
Mantidæ, California species of 135
Map tortoise 379
Margarita, California species of 201
Marginella, California species of 212
Marginellidæ, California species of 212
Marine invertebrates, new species of 1
Marron, Thomas, cited 396
Maryland, crabs from 238
Marsh Tits, Japanese 343
Marsh, William A., unio collection of 406
Mask, Alaskan 221
Massachusetts, crabs from 236–275
Medal, Chinese, found in Alaska 221
Megatebennus bimaculatus 198
Megaderma cor, figure of 468
frons 469
Melampus olivaceus 196
Mellivora capensis 455
Melodes calliope 321
Menidia tenuis 145
Menticirrhus undulatus 154
Merlucius productus 174
Meske, O. 45
Mexico, new species of crabs from 242
new species of birds from 119

	Page.
Mexico, notes on fishes from	283
parasites from	89
Microphrys bicornutus	252
Miers, E. J., classification of crabs by	231
Mionectes semischistaceus, new species	27
Mills, George T	481
Mississippi, drainage area of river	406
snakes from	390
Missouri, blind cave salamander from	115
new species of insects from	367
Mithrax aculeatus	264
(Nemausa) acuticornis	260
bahamensis, new species	267
braziliensis, new species	268
cinctimanus	268
coronatus	272
cristulipes	273
denticulatus	272
forceps	269
figures of species of	277
hemphilli, new species	262
hispidus	265
nodosus	273
pilosus, new species	262
sinensis, new species	266
sculptus	271
(Nemausa) spinipes	259
spinosissimus	261
verrucosus	265
Mithracinæ, subfamily	259
Mitra maura	211
Mitridæ, California species of	211
Mitromorpha, California species of	208
Modiola, California species of	191
Mola mola	175
Molidæ, California species of	175
Mollusca of San Pedro Bay	182
Mollusks of Florida	405
Monkeys, East African	448
Monks, Miss S. P	179
Monoceros, California species of	214
Montana, fossil plants from	487
Monticola manilla	318
Mopalia, California species of	196
Mopaliidæ, California species of	196
Morphology of grass-flower, Holmon	399
Moqui, Indian maidens in	30
Morrisonia, characteristics of	78
bisulca	82
confusa	85
evicta	83
mucens	80
revision of genus	65
rileyana	81
illustrations of genitalia of	86
infidelis	84
peracuta	84
Morrison, H. K., insects collected by	73
Motacilla grandis	312
lugens	305, 358
Motacilla melanope	313
Mugil cephalus	144
Mugilidæ, California species of	144
Muricidæ, California species of	214
Muricidea, California species of	216
Murænidæ, California species of	143
Mus aquilus, new species of mouse	460
arborarius	459
barbarus	460
minimus	462
Myacidæ, California species of	183
Myctophum townsendi	142
californiense	142
Myliobatis californicus	135
Myliobatidæ, California species of	135
Mytilidæ, California species of	191
Mytilus, California species of	191

N.

	Page.
Nanotragus moschatus	478
Nassa, California species of	212
Nassidæ, California species of	212
Natalinæ, new subfamily of bats	437
Natalus stramineus	438
Natica (Lunatia) Lewisii	211
Naticidæ, California species of	211
Navajo Indians, costumes of	280
house-building by	279
Nematoda in Yellowstone Park	88
Neoclinus blanchardi	173
Neotragus damarensis	477
Nettastomella Darwinii	182
Nettion formosa	292
Neumoegen, Mr., insects from	46
New genera of bats	441
insects	41, 53, 65, 366, 367, 368
species of antelope	473
bats	442
birds	119, 342, 371
crabs	1, 231
Dedromys	462
fishes from Mexico	283
fossil plants	490, 492, 493, 494
mouse	460
Sciurus	465
subfamily of bats	437
subspecies of birds	347
Newberry, Dr., cited	487
New Jersey, crabs from	238
New Mexico, new species of birds from	119
Navajo Indian houses in	279
New Zealand, crabs from	243
Noctuidæ, John B. Smith on	33-86
genus Xylomiges of	65
Norman, Rev. A. M., crabs collected by	243
Norrisia Norrisii	200
North Carolina, crabs from	236-275
North Pacific exploring expedition	232
Nucula (Acila) castrensis	192
Nuculidæ, California species of	192
Nuttallina scabra	196
Nycteris thebaica	469

O.

	Page.
Oates, Mr., on birds of India, quoted	346
Ocinebra, California species of	215
Octopodidæ, California species of	217
Octopus punctatus	217
Odostomia, California species of	209
Œdalina, California species of	186

Page.

Oedemia americana, parasites of 87, 92
Oligocottus analis 168
Olivella, California species of 212
Olividæ, California species of 212
Omphalus, section 200
Opalia, subgenus 210
Ophidiidæ, California species of 173
Ophiodon elongatus 162
Orcynus alalonga 149
Ornithion pusillum subflavum, new subspecies 28
Oryx callotis from East Africa 470
pencil-eared 470
Osmunda dichsonioides 493
Ostrea, California species of 193
Ostreidæ, California, species of 193
Otago University Museum 243
Othonia aculeata 255
carolinensis, new species 256
figures of species of 277
lherminieri 255
nicholsi, new species 257
rotunda, new species 258
Othoniinæ, subfamily 255
Otocyon megalotis, dimensions of skull of 456
Otocoris alpestris 301
Otomys irroratus 464
Otophidium taylori 173
Ova of California fishes 125
Ovula (Simnia) deflexa 206
Ovulidæ, California species of 206

P.

Pachypoma inæquale 199
Paralabrax clathratus 150
maculofasciatus 150
nebulifer 151
Paralichthys californicus 174
Parapholas californica 182
Parasites of birds 87
Pariceliuus hopliticus 170
Parus ater 344
hensoni, new species 342
Pandoridæ, California species of 183
Patagonia, hermit crabs from 4
Pavoncella pugnax 292
Peale, Dr. A. C., fossil plants collected by 487
Pecopteris montanensis, new species 492
Browniana 492
Pecten, California species of 193
Pectinidæ, California species of 193
Pedipes unisulcatus 196
Pelecanus erythorhynchus, parasites of 88
Pentacnemus bucculatricis, new species 366
new insect genus 366
Perch, California species of 156
Pericera, species of, in National Museum 243
atlantica, new species 247
contigua, new species 247
cornuta 244
calata 244
triangulata, new species 246
tumida 277
Periceridæ, catalogue of, by Miss Rathbun 231
key to families and genera of 232
list of, in National Museum 274

Page.

Pericerinæ, subfamily 235
Periploma discus 184
planiscula 184
Perkinsia othonops 137
Perkins, Hon. George C 137
Petricola, California species of 189
Petricolidæ, California species of 189
Phacochœrus ælianii 479
Phanerodon atripes 157
furcatum 157
laterale 156
orthonotus 157
Phasianella compta 199
Phasianellidæ, California species of 199
Phœnicurus auroreus 321
Pholadidæ, California species of 182
Pholadidea, California species of 182
Pholas pacifica 183
Phoxinus oreuttii 135
Phyllostome bats, new subfamily of 437
Phyllopseustes borealis xanthodryas 338
tenellipes 341
Picroceroides tubularis 248
Picus canus jessoensis 300
Pilsbry, Mr. H. A 198
Placunanomia (Monia) macroschisma 194
Platyglossus semicinctus 157
Platyodon cancellatus 183
Pleuronichthys coenosus 174
Pleuronectidæ, California species of 174
Pleurotoma, California species of 207
Pleurotomidæ, California species of 207
Pneumodermatidæ, California species of 194
Pneumodermon pacificum 194
Podiceps nigricans 290
Poliomyias ferruginea 331
Pomacentridæ, California species of 158
Pomacentrus rubicundus 158
Pomaulax undosus 199
Pompano in California 150
Porichthys margaritatus 171
Postell, J., unio collection of 412
Potamochœrus africanus 479
Pratincola maura 323
Prionorhynchus edwardsii 243
Procavia brucei 459
Psammobia rubroradiata 185
Psephis tantilla 188
Pseudojulis modestus 158
Pteronotus festivus 216
Pteroplatea marmorata 134
Pteropoda, California species of 194
Pterorhytis, California species of 215
Purpura lima 214
Putnam, Prof., cited 387, 388
Pyramidella, California species of 208
Pyramidellidæ, California species of 208
Pyrrhula griseiventris 353

R.

Ranella californica 211
Rathbun, Miss Mary, on crabs of family Pericerida 231
Rathbun, R., crabs collected by 264, 269, 273
Rattlesnake Island, shells on 180

Page.

Rattlesnake, breeding habits of 386
Raymond, W. J., collected shells 183
Reedbuck of East Africa 472
Regulus japonensis 346
Remora remora 148
Reptiles, shield 380
Rhacochilus toxotes 157
Rhinobatidæ, California species of 134
Rhinobatus exasperatus 134
productus 134
triseriatus 134
Rhinoceros bicornis 479
Rhinotriacis henlei 133
Rhizomys splendens, dimensions of skulls of 465
Rhode Island, crabs from 236–275
Ribbon-snake, breeding habits of 390
Rictaxis, section 195
Ridgway, Robert, on new forms of Basileuterus rufifrons 119
Riley, Dr. C. V 37
Ringer, Mr., birds collected by 311
Rissoa (Alvania) reticulate 206
Rissoidæ, California species of 206
Rock House Cave, salamander from 116
Roeper, Joh., cited 400
Roncador stearnsi 152
Rugel, F., unio collection of 406, 413
Rupellaria lamellifera 189

S.

Salmo irideus 142
mykiss agua-bonita, Dr. Jordan on 481
Salamander, new genus and species of blind 115
Salmonidæ, California species of 142
Sampson, F. A., new blind salamander discovered by 115
San Diego, Cal., fishes of 123–178
San Pedro Bay, shells of 179
Sanguinolaria Nuttallii 185
Sarda chilensis 149
Saxicava, California species of 183
Saxicavidæ, California species of 183
Saxidomus, California species of 189
Scala, California species of 209
Scalidæ, California species of 209
Scaphopoda, California species of 194
Schizothærus Nuttallii 183
Schneck, Dr. J., cited 389, 392
Schumann, Karl, cited 400
Sciæna saturna 153
Sciænidæ, California species of 152
Sciurus poensis, measurements of 467
undulatus, new species 465
Sclater, Dr., antelope collected by 477
cited 470
Scomber colias 148
Scomberesox brevirostris 143
Scombridæ, California species of 148
Scopelidæ, California species of 141
Scorpæna guttata 168
Scorpænichthys marmoratus 171
Scorpænidæ, California species of 162
Scotophilus temminckii 443
Scyllidæ, California species of 132

Page.

Scylliorhinus ventriosus 132
Sebastodes æreus 165
atrovirens 164
auriculatus 167
carnatus 168
chlorostictus 165
chrysomelas 167
constellatus 165
eos 165
flavidus 163
gilli 165
goodei 163
levis 165
melanostomus 164
miniatus 164
mystinus 163
elongatus 165
ovalis 163
pancispinis 163
proriger 164
pinniger 164
rosaceus 164
ruber 164
rufus 163
rubrovinctus 166
rastrelliger 167
serranoides 163
serriceps 168
vexillaris 167
Seebohm, Mr., cited 301
Seiss, C. Few, cited 389
Semele, California species of 186
Seriola dorsalis 149
Septifer bifurcatus 191
Seriphus politus 154
Serpulorbis, California species of 204
Sequoia ambigua 494
rigida 494
Serranidæ, California species of 150
Shells, illustrations of California 219
of San Pedro Bay 179
species used for plaques 187
Shepard, Miss I. M. 179, 185
Shepard, Prof., unios collected by 412
Shockley, W. H., collects trout 481
Shufeldt, Dr. R. W., on Navajo Indian houses 279
Wolpai maiden 29
Sidera mordax 143
Sigaretus debilis 211
Siliqua patula 185
Simpson, Charles T., on Unionidæ of Florida 405–436
Simpson, Charles Torrey 181
Siphonaria (Williamia) peltoides 196
Siphonariidæ, California species of 196
Siphostoma auliscus 144
leptorhynchum 144
punctipinne 144
Sitta amurensis 345
Slosson, Mrs., insects from 72
Smelt, top 146
Smith, Herbert H., insects collected by 366
Smith, John B., revision of Dicopinæ 53
genus Cucullia 33–52
on Xylomiges and Morrisonia 65

Page.

Smith, Rosa, on California fishes 125
Smith, Prof. S. I., cited 390
Snakes, Hay on breeding habits of 385
Solariella, California species of 202
Solen, species of, in San Pedro Bay 184
Solenidæ, California species of 184
South Carolina, crabs from 236–275
Sparidæ, California species of 152
Sphæroides politus 175
Spinacidæ, California species of 132
Spiny boxfish of California 485
Spiroglyphus lituella 204
Sphenolepidium virginicum 494
Sphyræna argentea 147
Sphyrna zygæna 134
Sphyrænidæ, California species of 147
Sphyrnidæ, California species of 134
Squalus acanthias 132
Squatina squatina 134
Squatinidæ, California species of 134
Star-gazer, new species of 121
Stearns, Dr. Robert E. C 181
cited 407
Stearns, Frederick, crabs collected by 231, 268
Stejneger, Leonhard 378, 393
on new blind cave salamander 115
on birds from Yezo, Japan 289
on new species of Japanese birds 371
Stenobrachius leucopsarum 142
Stimpson, Dr. William 232
on crustacea 276
Stolephoridæ, California species of 137
Stolephorus, development of eggs of 138
compressus 140
delicatissimus 138
rigens 137
Stonechat, eastern 323
Strecker, Herman, cited 390
Streets, Dr. T. H., crabs collected by 225
Stereolepis gigas 151
Stromateidæ, California species of 150
Stromateus simillimus 150
Stultz, W. H., insects from 57
Sturnia violacea 349
Swordfish in California 143
Symphurus atricanda 175
Syngnathidæ, California species of 144
Synodontidæ, California species of 140
Synodus lucioceps 140

T.

Tænia compressa, new species 108, 113
filum 106, 113
fusus, figure of 112
macrocantha, new species 107, 113
porosa 103, 112
Tagelus, California species of 184
Tanaostigma coursetiæ, description of 364
figure of 369
Tapes, California species of 188
Tarletonbeania tenua 141
Taxodium (Glyptostrobus) ramuosm 494

Page.

Telmessus, Alaskan species of 223
cheiragonus, figure of 224
and Erimacrus, Benedict on 223
Tellina, California species of 195
Tellimya tumida 191
Tellinidæ, California species of 185
Temminck's bat, Allen on 443
Terebra, California species of 207
Terebratella transversa 182
Terebridæ, California species of 207
Terekia cinerea 292
Terrapin, called map tortoise 379
food habits of 382
Tetrachemus, insect genus 362
Tetrachemus diversicornis, figure of 369
Tetracladia, new insect genus 367
gracilis, new species 368
texana, new species 367
Tetrachemini, insect tribe 361
Tetraodontidæ, California species of 175
Thalotia caffea 201
Thaxter, Dr. 44
Thoe puella 274
Thomas, M., on East African mammals 446
Thracia curta 184
Thrush, blue and red rock 318
Thyrsopteris microloba 493
rarinervis 494
Tiarinia cornigera 243, 276
depressa 276
spinigera 277
Tivela, California species of 187
Toads, ejection of blood from eyes of 375
sacred 377
Tokio, Science College Museum in 371
Tooth, egg, of snakes 394
Tornatina, California species of 195
Tornatinidæ, California species of 195
Tortoise, map 379
Tortoises, Gray's catalogue of, cited 381
Trachurus picturatus 149
Tragelaphus scriptus roualeynii 471
Tree daman, figure of skull of 480
Trematoda from Yellowstone Park 93
Triacis semifasciatus 133
Tringa canutus 292
temminckii 371
Trigonochirus, subgenus 8
Tritoniidæ, California species of 211
Trivia, California species of 207
Trochidæ, California species of 199
Trochocopus pulcher 157
Trophon (Boreotrophon) triangulatus 216
Tropidonotus, breeding habits of 390
Trout, cut-throat 482
golden, of Kern River 481
Trowbridge, Mrs. L. H 179
True, Frederick W 441
on mammals from East Africa 443
Truncatella, California species of 206
Truncatellidæ, California species of 206
Turbinidæ, California species of 199
Turbonilla, California species of 209
Turdus cardis, measurements of 314

Page.

Turdus, chrysolaus 316
eunomus 315
naumanni, measurements of..... 315
obscurus 317
pallidus 316
Turritella, California species of..... 205
Turritellidæ, California species of 205
Turtles of genus Malaclemys, O. P. Hay on 379
Tylodina fungina 195
Tylosurus exilis 143
Typhlogobius californiensis 159
Typhlotriton, new genus of salamander ... 115
spelæus, new species..... 116

U.

Unio ahenens..... 431
amygdalum 426
anodontoides..... 430
Buckleyi..... 417
camptodon.....427, 432
complanatus 411
concestator 416
coruscus 419
crassidens 410
Cunninghami 422
dariensis..... 413
denigratus 422
dorsatus 411
Downiei 413
Ferrissii 423
fuscatus 420
Forbesianus 410
gibbosus 431
Hinkleyi..... 423
hopetonensis..... 412
infucatus 409
illustrations of species of..... 433
insulsus 4:2
Jayanus 419
lepidus..... 426
lugubris 424
micans 423
minor 425
modioliformis 414
monroensis 410
nasutus 431
nashvillensis..... 416
obesus 428
obnubilus..... 424
occultus 420
ocmulgeensis 424
papyraceus 427
parvus..... 425
pusillus..... 411
rotundatus..... 429
Singleyanus 426
spissus 413
squalidus..... 429
subangulatus 415
succissus 429
subgibbosus 432
subluridus, new species..... 432
tenerus 416
tortivus..... 421
trossulus 427

Page.

Unio vesicularis 425
Waltoni..... 431
Umbraculidæ, California species of..... 195
Umbrina roncador 154
Underwood, C. F 27
Underwood, Prof. L. M., on horned toads.. 377
Unionidæ, classification of..... 408
of Florida, Simpson on 405
geographical distribution of.... 406
Union College Museum, crabs in 231
Uragus sanguinolentus 354
Urinator pacificus 291
Urolophus halleri..... 134
Urophlexis ussuriana..... 341

V.

Venericardia ventricosa 190
Veneridæ, California species of..... 187
Venus toreuma 188
Vermetidæ, California species of 204
Viper, breeding habits of 392
Virginia, crabs from.....236–275
Vitrinella Williamsoni 202
Volvula, California species of..... 195

W.

Wallace, A. R., cited 378
Wallace, John, on blood ejection by toads. 378
Wallace, W. O., snakes collected by..... 391
Water buck of East Africa 471
Water-moccasin, breeding habits of..... 386
Water-snakes, breeding habits of..... 390
Weinland, Dr., cited..... 386
Wheatley, C. M..... 411
White pelican, parasites of 89
White, Rev. G., unios collected by..... 432
Whitefish of San Diego Bay..... 158
Williamia, subgenus of mollusks..... 196
Williams, R. S., fossils from..... 494
Williamson, Mrs. M. Burton, on shells of San Pedro Bay..... 179
Williamson, Miss Virgie Burton..... 185
Williston, Prof. S. W., cited..... 387
Willoughby, Capt., on East African mammals 446
Woodpeckers, Japanese..... 300
Wolpai, a maid of, Dr. Shufeldt on..... 29
Wright, B. H., collected Unionidæ.....405, 414
Wryneck, Japanese..... 296
Wyoming, avian entozoa in..... 107

X.

Xenistius californiensis 152
Xerus rutilus 467
Xiphias gladius..... 148
Xiphiidæ, California species of..... 148
Xylomiges characteristics of 65
crucialis 69
curialis 71
dolosa..... 71
genus, revision of..... 65
hiemalis 68
illustrations of genitalia of 86
patalis 76
ochracea, new species..... 75

	Page.
Xylomiges perlubens	72
peritalis, new species	69
rubrica	73
subapicalis	74
tabulata	77
Xystreurys liolepis	174
Y.	
Yarrow, Dr., cited	389
Yellowstone Park, parasitism of trout at	87
Yellow tail	149
Yezo, collection of birds from	289
Yoldia cooperi	192
Yucatan, crabs from	237
Yungipicus kizuki, measurements of	299
seebohmi	297
Z.	
Zamites montanensis, new species	494
Zaniolepis frenatus	162
Zanthopygia narcissina	334
Zanzibar pygmy antelope	478
Zirphæa crispata	182
Zosterops japonica	342
Zuni Indians, marriage customs of	31

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